

# B777 Captain's 'Unofficial' Manual

The 777 Go-faster book



## **Disclaimer**

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This manual is for the use of experienced pilots who are familiar with the Official BA Manuals. The information in this Aide Memoir is for guidance and information only and does not replace the Official Manuals. It is not updated on a regular basis and has not been officially endorsed. It must not be used on the aircraft.

The author cannot be held responsible for any errors or omissions and accepts no liability whatsoever for any loss or damage howsoever arising.

It is up to you, as a professional pilot, to ensure that the information is, in fact, accurate. Much of the information has been gleaned from quizzing training Training Captains and writing up the information they have given me, and is given in good faith.

Errors or omissions should be forwarded to the Author ASAP.

## **Acknowledgments**

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The author acknowledges the valuable contributions by M R Bowman, David R, Steve Bentley, R I. Thanks also to all my other correspondents for making this manual as up to date as possible.

All Trade Marks acknowledged.

10 9 8 7 6 5 4 3 2 1

Amendment	Date	Notes
1—25Am	Dec 06 Aug 08 Feb 09	<p>New items: ATIS phone nos / Diversion</p> <p>Additions to Incapacitation &amp; Editorial changes. Minor change to internal links on pdf file</p> <p>New FM No 8 amendments + Misc additions Minor changes as per PB</p> <p>Emergency turn note - inform ATC (2.1 &amp; various) Emergency approaches 11.22</p> <p>Engine surge - TAC will not work 11.6/11.7</p> <p>QFE Ops 13.3. Small changes due to new FCOs - not fully done yet</p> <p>Updates to new FCO references. P7.1 – 7.7</p> <p>Reformatted page margins to allow more editorial space. Hence new series number. Artefacts may be found.</p> <p>Updates to AWOPS to take in new US procedures - these need to be proof read.</p> <p>More old FCO numbers changed to new system. Again these need to be fully checked out as the translation between systems may not be perfect. TCAS R/T changes &amp; additional notes.</p> <p>NDB - NPA 6.5. Non-ILS NPA 6.11 (New section added)</p> <p>Ice/Rain changes to 8.3/8.4 - HOT, &amp; deicing</p> <p>PAX EVACUATION 10.4</p> <p>Changed some colour formatting.</p> <p>CSD replaced by Cabin Manager. A/T changed to ATS; Pax evacuation amended 2-9; Diversion 6-17</p> <p>ETOPS rules amended 7-2 / 7-3; APU fire 10-2; Eng fail in cruise 11-14; Landing gear/brakes 11-38</p> <p>Added new section Mental Calcs. 13-6</p>
25Bf - Cd	Mar 09	<p>More QRH references updated, especially Section 10 &amp; 11.</p> <p>RTO 2-7/8; Unreliable Airspeed C/List 10-3 &amp; 11-29. EFATO 11-3/5</p> <p>Tail Pipe Fire 11-17; Flap Drive 11-26</p> <p>Slats Primary Fail 11-27; Stall recovery 11-29</p> <p>Emergency Descent 11-41/4</p> <p>ATS changed back to A/T. Ref 'TM 12-' changed to 'TM[FC2]' &amp; 'FM02-' / 'FM01-' changed to 'FM[FC1]' (but references not necessarily updated).</p> <p>Gen planning 7-2; Stabilised app</p> <p>Eng Lim/Stall 11-6; EGT exceedence T/O 11-10</p> <p>SE App &amp; Ldg 11-7; SE G/A 11-8; SE Circling 6-16; Unreliable Airspeed 11-29</p> <p>Flaps/Slats 11-23; Flaps Drive 11-26; Fuel Imbalance 11-31; Fuel Qty Low added 11-32</p> <p>Single Hyd loss 11-34; Gear 11-38; add Flat tyre ldg 11-39</p>
β 31Aa 3 issued	Jan 10	<p>Added -300ER taxi info 2.3 (this adds extra page to whole section)</p> <p>15kt&gt; Min Man 3.1</p> <p>Wind corrections 6.2. Avoid Hi energy apps 6.4. Minor changes to 6.12. Additions to G/A 6.13</p> <p>HOT updates 8.3. Taxi in with EAI 8.7. TAT probe icing added 8.6.</p> <p>Procedures updated 9.2 &amp; 9.4</p> <p>Eng Abnormal start updated 11.10. OTS route info added 11.14/15. Fire Cargo updated 11.18. Fire Fumes/removal major update 11.2</p> <p>Use FPV - flt unreliable airspeed 11.29. Fuel Qty Low updated / Fuel leak added 11.32</p> <p>Door xx/ cargo updated 11.46. EGPWS &amp; Windshear updated 11.47/11.48. TCAS updated 11.50/11.51</p> <p>-300 info added 13.1 / 13.4. Minor change to 13.2. &amp; Fuel limits 13.3. Min Circling added 13.5</p> <p>Various refs updated due changes in QRH.</p>
β 31Ca 1 issued	Jan 10	<p>2.1 Ldg gear extended prohibits RVSM / 2.4 Warm up time remote holding.</p> <p>2.7 Constrained departures / 2.10 Emergency Evac - Rapid disembarkation</p> <p>11.2 After emergency is over. / 11.11 Start parameters updated</p> <p>11.21 Ditching updates. / 11.34 HYD PRESS SYS C updated. / 11.43 minor changes</p> <p>4.1 &amp; 13.5 RVSM minor changes /</p> <p>Minor editorial changes 'FM[FC1]' updated to 'FCom1'</p>
31Cb-Fe 1 issued	Jan 10 Sep 10 Nov 10	<p>6.8 / 6.10 / 6.11 Non ILS apps etc. Common errors added.</p> <p>11.11 Eng Ignition tech details added</p> <p>11.32 Fuel tolerances added</p> <p>13.2 1. 3g manoeuvre capability added</p> <p>Editorial &amp; fonts updated. Ice Rain 8.1 correct sign &lt;. Final Spell check</p> <p>Correction to 2.1 (h/tip T E). Added Bookmarks. Addition to 180 turns (h/tip EM)</p> <p>1.1 Early departure; 2.8 &amp; 11.2 Emergency on R/W PA; 6.4 &amp; 6.16 Vis app 1500ft; 6.6 NPA; 6.14 SEG parking; 11.38 Gear pins.</p>
32Af	Aug 11	<p>1.5 - 1.9 Planning Criteria. Std PAX wts, Deportees, O2 min FICO codes</p> <p>2.1, 2.3, 2.5, 2.9 RTO, U turns on RWY, RTO</p> <p>4.2 Fuel policy</p> <p>5.1 Cold fuel procs removed. Ldg assured defn.</p> <p>6.2, 6.4, 6.5, 6.8, 6.13 Ldg Flap 300 diff, 50ft removed, Non ILS, G/A mode handling,</p> <p>7.1/2 Altn A/f, Planning Criteria</p> <p>8.4/5 Deice with APU, Ramp. Core ice</p> <p>Section 10 all</p> <p>11.6 Eng LIM/Surge etc. 11.13 Dula Eng fail, 11.43 Decompression, 11.29 Unreliable a/s, 11.31 Fuel jettison, 11.50 W/shear summary</p> <p>13.1/2 Gross wts, Cabin crew. Taxy stong winds. 13.5 A/P aileron trim.</p>

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# 1 • Flight Planning

## Fuel Planning

Extra departure fuel required for increased hold time at destination						
Extra fuel/time =	1400Kg or 15 min		2800Kg or 30 min		5600Kg or 60 min	
Flt Time (Hrs)	Fuel to load	Extra Burn	Fuel to load	Extra Burn	Fuel to load	Extra Burn
3	1505.0	105	3010.0	210	6020.0	420
4	1540.0	140	3080.0	280	6160.0	560
5	1575.0	175	3150.0	350	6300.0	700
6	1610.0	210	3220.0	420	6440.0	840
7	1645.0	245	3290.0	490	6580.0	980
8	1680.0	280	3360.0	560	6720.0	1120
8.5	1697.5	298	3395.0	595	6790.0	1190
9	1715.0	315	3430.0	630	6860.0	1260
9.5	1732.5	333	3465.0	665	6930.0	1330
10	1750.0	350	3500.0	700	7000.0	1400
10.5	1767.5	368	3535.0	735	7070.0	1470
11	1785.0	385	3570.0	770	7140.0	1540
11.5	1802.5	403	3605.0	805	7210.0	1610
12	1820.0	420	3640.0	840	7280.0	1680
12.5	1837.5	437	3675.0	875	7350.0	1750
13	1855.0	455	3710.0	910	7420.0	1820
14	1890.0	490	3780.0	980	7560.0	1960
15	1925.0	525	3850.0	1050	7700.0	2100

Based on an extra 25 kg/ton/hr (Av calculated from Cirrus). Average burn in flt  $\approx 6\frac{1}{2}$  tons/hr. (7 tons/hr @ 270 tons).

### FCPM Fuel Penalties

(A[1] 8.1.7.13 Jun 08)

Increase in ZFW = 40 kg/hr/ton. [ $\equiv +4\%/hr$ ] (Time to apply is T+C+D+R, i.e. total endurance).

Increase in Diversion Fuel = 40 kg/hr/ton. (Time to apply is T+C).

Uplift extra fuel = 40 kg/hr/ton. (Time to apply is Trip time).

Reduced RTOW = 30 kg/hr/ton. [ $\equiv -3\%/hr$ ] (Time to apply is T+C+D+R, i.e. total endurance).

### Night flights at LHR/LGW

Night period: 2300—0700L: Quota period LHR/LGW: 2330—0600L, based on wheels off/on time.

BA Night movement: STD 2315L or later (wheels off 2328L), or  
STA 0615L or earlier, but must not land (wheels on) before 0432L - ignore ATC permission.

All others to land after 0602L.

Note times are LOCAL.

Do not land at LHR before STA-20, aiming for on gate between STA-15 & STA.

(A[1] 8.10.4.1 Jan 10)

At LHR alleviation to land before 0602L only for:

- ❖ emergency
- ❖ LVPs in force with ATC request to land
- ❖ diversion due to unforeseen circumstances

If STA of 0500L or later, not to be on stand before 0500L.

Noise Limits: 0700—2259L 94dB(A)  
2300—2329L 89dB(A)  
0600—0659L 89dB(A)  
2300—0559L 87dB(A)

No dispensations & Capt will need to explain circumstances.

Early departures are not permitted, except that up to 10 mins early not seen as an early departure.

(A[1] 8.10.2.2 Jan 10)

## Fuel Burn & Penalties

2000ft above optimum 1-2% increase.	(FCom1 NP-60-4 Oct 08)
2000ft below optimum	
4000ft below optimum 4 -5% increase	
8000ft below optimum 12-15% increase	
Cruise 0.01 above ECON 1-2% increase	
Speeds above M0.84 increase burn significantly.	(A South)
Packs 2%??	
Recirc fan switched off 0.7% for each one.	(TM[FC2] 02-20-02 Jan 09)
For 2 unserviceable recirc fans is 0.7% plus 0.3% for any additional unserviceable fans (i.e. 3 off = 1.0% and all 4 off = 1.3%)	(T E)(MEL 21-25-1 Rev 10)
Eng out range penalty 12%???	
APU penalty in flt due door 2.5%	(FCom1 PI-16-2 et al / MEL-24-21 Jun 10)
4000ft Step Clb uses 200 kg & requires 90 mins to recover fuel.	(FCom1 NP-50-5 Mar 03)
Hold approx 400 kg (5500 kg/hr [GE85B, 200 tons, 10000ft])	(QRH PI et seq)
Typical 15 mins hold uses 1000 kg (At LHR & includes descents) (As observed)	
Holding beacon to touch down: 20 kgs per track mile to be flown (i.e. 20 x DTG)	(J B)
G/A & radar circuit LHR 1000 kg	(S Wydra)
Holding with FLAP 1 at VREF30+ 60, uses 5% more than FUP	(FCom1 NP-70-2 Mar 08)
Taxi fuel burn: 1800 kg/hr (600 kg/20min, 30 kg/min)	(Typical cirrus)

An en-route climb penalty incurs a fuel decrement of 1% per 1000 kg of en-route climb penalty. (CDL 08-02-00-2)

APU Fuel burn:

- \* APU burn on GRD approx 300 kg/hr (Fluid Repl Man Sec1.6)
- \* APU fuel burn on grnd (MEL) 240 kg/hr (MEL-24-21 Jun 10)
- \* APU fuel burn in flt: 90 kg/hr (MEL-24-21 Jun 10)
- \* Not normally left running with transits >1hr. (Fluid Repl Man Sec1.6)
- \* APU penalty in flt due door 2.5%

## Fuel Freezing & Second Sector

(FCom1 NP-50-9 Mar 03)

- ❖ Fuel tank temp should be maintained at 3°C above Fuel Freeze pt.
- ❖ FMC default freeze point is -40°C.
- ❖ Fuel temp will trend to the indicated TAT at 3°C/hr.
- ❖ TAT is approx 30°C above SAT @ M0.84 cruise.
- ❖ A SAT of -63°C will be critical temp for -40° fuel, (TAT ≈ -33°).
- ❖ Following a -40°C fuel sector, if A/C fuelled with -47° fuel, freeze point can be taken as -42°.
- ❖ -40° fuel in the centre tank is not a factor.

## Fuel Tanking

(Perf M. 5.15 Dec 99)

- ❖ Not permitted if icy/slippery/contaminated RWY for T/O or Ldg

## Cntr Wing Tank

(TM[FC2] 12-20-5 Apr 03)

- ❖ Fuel starts to load into CWT at approx 56 tons (A model); 58 tons IGW A/C.
- ❖ Fuel scavenge starts when either main tank < 9100 kgs (ZA-ZE); <13100 kg (Rest of fleet).
- ❖

*Uncontrolled document - health warnings apply*

CIRRUS Fuel Policy				
Fuel	–	Typical		
TIF	38614	6.21	Brake release to TDown. (CIRRUS: Assumed R/W & SID and assumed STAR & R/W). Dest TAF @ ETA ± 1 hr ≥ RVR mins (or CC ≥ MDH if NPA). T/O Altn within 120 min Eng Out, (≈ 800 nm) / 60 min in USA. Normal minimas except USA. State min to be taken into account. Fire & LCN to be considered.	
CONT	1318	15	For unforeseen variations - used any time after pushback.	
			Statistical Contingency Fuel (SCF) available...	
			Replaces need for EnRte Altn (although this is often quoted on CIRRUS). Long Haul: get 95% coverage except... ANU, BGI, GND, LOS, LUN, MRU, NBO, SEZ, UVF which get 99% coverage. Min SCF is 5 min holding at destination at 1500ft, clean & at planned ldg wt. <b>Last min increase in req fuel:-</b> use 90% coverage.	
			If No Statistical Fuel Available...	
			NO ENROUTE ALTN	ENROUTE ALTN available
			Greater of:- • 5% TRIP Fuel, • 15 min hold @ 1500ft clean @ DEST ldg wt . <b>Last min increase in req fuel:-</b> Can reduce to a min of 5% TRIP. (Applies if 15 min CONT > 5% TIF).	Greater of:- • 3% TRIP Fuel, (1350 typical on 7¼ hr flt) • 15 min hold @ 1500ft clean @ DEST ldg wt. (1350kg typical). • 5% ABM ER Altn,** (700kg typical) <b>Last min increase in req fuel:-</b> Can reduce to a min of 5% ABM ER Altn, (700kg typical).
DIV	2680	25	From start of G/A to T/Dwn – assumes CONT used up & LRC (CI =0). Div contingency not req.	
RES	2571	30	30 min @ 1500ft @ planned holding wt @ Altn A/F (This is MIN fuel for ldg – ASR required). Island reserve replaces DIV+RES = 2 hrs normal cruise consumption @ FL 350 @ planned ldg wt & cruise CI.	
REQ	45183	7.31		
ETOPS	0		Critical fuel scenario	
EXTRA	0		Tanking / commercial fuel	
TAXI	490	(15)	For eng start, taxi and APU usage. Use 30 kg/min.	
TANKS	45673			
** ER ALTN			• ALTN TAF @ ETA ± 1 hr, uses stepped down limits, (see Sec 7.1 AWOPS & AOM) • Within circle rad = 20% DIF. • Circle centred en route, dist from destn greater of 25% DIF or 20% DIF + 50nm.	
			Note: must be OK A/F & open. Do not require: • Fire Cat; • State Altn min; • Local Restrictions	
Note: Crossover point for 3% TIF & 15 min holding approx 44,000 Kg (7¼ hrs).				



## Flight Planning

### Airfield Fire Category (ICAO RFF)

(A[1] 8.11.6 Jan 11 / Perf M 4-1-6 Nov 98)

777 fire category = 9

All A/Fs in performance manual are suitable.

- ❖ Destination and Destination Altn Airfields not less than Category 7. (i.e. 9 minus 2)
- ❖ All other Altns (T/O, Enroute, ETOPS): RFF Cat 4 at 30 mins notice (may be local community services).
- ❖ Operations below the above limits require approval of company fire protection manager.

In the case of all Altns with < RFF 9, request RFF to be at "Local standby" for T/O & Ldg. (Destination A/F is taken care of by Operations)

Management approval required for positioning flts where RFF has been withdrawn (No RFF cover is legally required for a Non Public Transport flt).

#### Background

The ICAO airfield fire category is determined from the length & maximum width of the fuselage and frequency of movements of the largest aircraft normally using that airfield.

### Take Off Altn A/F

(A[1] 8.1.2.8 Jun 08)

- ❖ Choose a T/O Altn if you cannot return to departure A/F due met or performance reasons. Must be annotated on flt plan. For 777, return to departure A/F with SE A/Land OK, except if RWY slippery.
- ❖ For ETOPS (Crew & A/C approved): T/O Altn within 120 mins at one eng cruise speed (800nm), (except USA/Saudi – 60 min).
- ❖ For non ETOPS: T/O Altn within 60 mins at one engine cruise speed, (400nm).
- ❖ If nominated: T/O Altn TAF at Altn ETA  $\pm$  1 hr must be at or above:–
  - \* Normal operating min. (Only RVR's taken into account).
  - \* Consider eng failure limitations, (i.e. not slippery RWY).
  - \* If the only approaches available are NPA / circling then CLG  $\geq$  MDH.

**Additionally for USA, Canada, Saudi:**

  - \* Ceiling/vis at T/O Altn (if req) must be  $\geq$  state Altn min, (and within 60 mins / 400nm).

Basic Altn Min (USA/Canada): 600ft/2sm (ILS), 800ft/2sm (NPA). For 2 separate RWYs, can use 200ft/0.5sm above the lower of the normal landing minima.

Canada complex. See A[1] man for Canada, Australia and Saudi.

(A[1] 8.1.3.1.4 Jan 11)

### General Planning Criteria

(FCom1 SP-60-02 Mar 08 / A[1] 8.1.3.0.2 Jan 11)

- ❖ BA only takes account of probabilities of **PROB 40** when selecting **Altns**. (Capt.'s discretion when looking at Destination WXR with less than PROB 40) (BALPA tech news Mar 03)
- ❖ PROB 30% and PROB 40% TEMPO are disregarded (A[1] 8.1.3.0.2 Jan 11)
- ❖ PROB 30% and PROB 40% forecasts are NOT considered for the T/O Altn or the destination.
- ❖ Cirrus cannot deal with **PROB 40 TEMPO**: & may be disregarded when selecting **Altns**.
- ❖ If no time band associated with **TEMPO** or **BCMG** then can be ignored for planning purposes.
- ❖ TEMPO are temporary changes < 1hr and in aggregate < ½ the period indicated.
- ❖ For **BCMG**: deteriorating conditions apply from start of period, improving conditions from end.
- ❖ Mean wind used for assessment, **gusts ignored**, except for ETOPS En Route Altns. (A[1] 8.1.3.0.2 Jan 11)
- ❖ Cloud CLG = the HAA to the lowest cloud obscuring more than 50% of the sky. (i.e. ignore FEW & SCT)
- ❖ Above criteria required at planning stage. Once airborne, use any A/F above OPERATIONAL limits.
- ❖ NuBrief valid for STD+1hr.
- ❖ TAF's & METAR's are °T. ATIS & Twr are °M.
- ❖ USA – Prob's only used for TS and associated WXR. (BALPA tech news Mar 03)

### Performance Calcs

(Perf M. 3.2.2 Jun 99)

- ❖ Temp Inversion – If forecast or evident, **AND** temp is ISA + 15 or more, add 3°C to reported temp to calculate TOPL. (Clear calm conditions @ night). (Perf M. 3.2.2 Jun 99)
- ❖ Gear down ferry: switch in the electrics bay which corrects the FMC!

### Useful FICO Codes

(Perf M. 3.2.2 Jun 99)

- |  |  |
|--|--|
| ❖ Airfields with adverse weather         | BADWX  |
| ❖ British airfields with adverse weather | BADWX BRIT   |
| ❖ Airfields with SNOWTAMS                | SNOWX  |
| ❖ Stations with SIGMET                   | SIGWX  |
| ❖ De-icing state of aircraft             | DICE <REG> where <b>REG</b> is the last 3 letters of registration. |
| ❖ Decode of SNOWTAM                      | MET 14421594   |

## A/C Loading

### CIRRUS: TOW / ZFW (Longhaul)

(A[1] 8-1-7-14 Jun 08)

New CIRRUS **required** if actual TOW is 5000 kg greater than planned TOW. No extrapolation of wt change figures above 5000 kg allowed. A new plan is NOT required for a drop in TOW, or if increased TOW is due to extra fuel loaded.

**APU fuel burn 300 kg/hr**

(Fluid Repl Man Sec 1.6)

**Taxi fuel burn 1800 kg/hr (600 kg/20min, 30 kg/min)**

(Typical cirrus)

Non-standard Taxi Fuel Weight and Balance

If extra Taxi Fuel above the standard figure uplifted then the total Fuel figure must be added to the TOW to ensure the Max TOW not exceeded.

The Maximum Taxi Weight must be entered in the 'Notes' box of the Loadsheel together with the endorsement 'Non-standard Taxi Fuel'.

### Loadsheel (Late-Close out)

(FCom1 NP-10-10 Mar 03)

Revised loadsheel required if fuel changed by more than  $\pm 1000$  kgs.

If change < 1000 kgs, use LMC procedure in L & B Manual.

Provisional loadsheel uses all male wts; final loadsheel uses split wts.

'Compliance with' loadsheel means:–

- ❖ TOW +1000 kg to –5000 kg,
- ❖ MACTOW and MACZFW are within  $\pm 2\%$ ,
- ❖ No changes to FMC required until suitable point in climb, normally FL200.
- ❖ FMC update not required for flts under 1 hour.

If issues do not agree, a copy of original must be obtained.

### Fuel LMC

(L &amp; Bal 05-10-01 Jan 01)

- ❖ Discrepancy between tech log & loadsheel. Capt authorised to adjust his loadsheel up to  $\pm 1000$  kg.
- ❖ Permitted provided that:–
  - \* Not practical to obtain new loadsheel,
  - \* NO operational, structural, or performance limits exceeded. (Especially if a + fuel discrepancy & increased traffic load). Request new loadsheel if limits likely to be exceeded.
  - \* Any adjustments signed confirms no exceedances.

### Fuel Tolerance & Discrepancy

(FCom1 NP-10-11 Oct 03 / L&amp;Bal 05-10-01 Dec 96)

Fuel Tolerance (Wide Body): is –0 / +500 kg. No change to loadsheel required if within tolerance.

FCR required if outside tolerance. New loadsheel if >1000 kg LMC limit.

(A[1] 8-1-7-14 Jun 08)

**Fuel Discrepancy after refuelling:–**

(FCom1 NP-10-11 Oct 03)

Stick check required if calculated arrival fuel differs from actual remaining fuel from previous sector by:–  
 $\pm 1\frac{1}{2}\%$  or  $\pm 1000$  kg of departure fuel, whichever greater.

### Fuel Loading

(FCom1 L-10-9 Mar 05)

# Fill wing tanks before CWT.

(CWT may hold up to 1360 kgs when main tanks not full, provided CWT fuel counted as ballast and added to ZFW. Max ZFW not to be exceeded. Observe C of G limits).

### PAX Wts (Long Haul - Not charter flts)

(L &amp; Bal WB-03-22 Jun 10)

Std Pax Wts (Unchecked wt in brackets & included in Pax wt)			
Pax	Long Haul	Japan	West Africa
Adult M	91 (9)	87	95 (13)
F	73 (9)	66	77 (13)
Child	38 (9)	36	42 (13)
Infant	0	0	0
Combined M/F	87 (9)	79	91 (13)

Combined M/F wts used when no capacity problems.

Standard PAX Bag wts 16 kg (Longhaul)

(L &amp; Bal WB-03-19 Jun 10)

F/Deck Crew 85 ) Includes cabin

Cabin Crew 75 ) but not hold bags.

Crew hold bags 16

(L &amp; Bal WB-01-24 Jun 10)

**Deportees/Inadmissibles**

(A[2] 2.22.2 Jan 11)

**Capt to be informed on all occasions**

Advice from BA Security Duty Manager ext 30999 (44 20-8513-0999 overseas)

Refusal by Capt to accept deportees for 'reasonable cause' to be reported by ASR, and explain to immigration.

**INADs (Inadmissible)**

- Max 6 per flt, except with security clearance, (family groups count as 1 INAD).
- If escort required, min 2 escorts per INAD.

**DEPO/DEPUs (Deportees)**

- Max 2 unescorted (DEPU) or 1 escorted (DEPA) per flt, (family groups count as 1 DEPO/DEPU)
- If escort required, min 2 escorts, more if family group.
- Capt may refuse carriage
- DEPO Documents (inc passport) to be handed to SCCM.

**Hold Layout**

(L &amp; B Man)

<b>Compartment 1</b>	Posns 11 Posns 12 Posns 13	<b>Fwd Cargo</b>
<b>Compartment 2</b>	Posns 21 ↓ Posns 25	
<b>Compartment 3</b>	Posns 31 Posns 32 Posns 33	<b>Aft Cargo</b>
<b>Compartment 4</b>	Posns 41 ↓ Posns 44	
<b>Compartment 5 (Bulk)</b>	Posns 51 ↓ Posns 54	

## Pre Departure

### FMC loading

(FM TM )

- ❖ FMC default max assumed temp = 58
- ❖ In event of a **GREENBAND** EICAS msg - check if you are in the “Known Nuisance Region”. (Fault Isoltn Man p292.42 Jan 03)

### Performance Calcs

(Perf M. 3.2.2 Jun 99)

- ❖ Temp Inversion – If forecast or evident, **AND** temp is ISA + 15 or more, add 3°C to reported temp to calculate TOPL.  
(Clear calm conditions @ night). (Perf M. 3.2.2 Jun 99)
- ❖ Beware ‘A’ market CARD performance may supply figures for wts above MTOW of 242.6.
- ❖ Gear down ferry: switch in the electrics bay which corrects the FMC!
- ❖  $Cloud\ base = \frac{(Temp - Dew\ Pt)}{2}$  (Assumes 2° lapse rate).

### ETOPS Dispatch restrictions

(MEL )

#### Air Conditioning Pack u/s

(MEL-21-70 Jun 10)

60 mins rule. Maintain F350 or below for cruise, (Except G-YMMR – MMU and 777-300ER aircraft).

#### APU Bleed Air Shutoff System(s) u/s

(MEL-36-29 / MEL-49-15 Sep 09)

180 mins rule. No dispatch if APU required by other procedures.

#### APU not available (APU / Fire systems / Fuel shut off valve u/s)

(MEL-28-21 / MEL-49-07 et al Sep 09)

180 mins rule. No dispatch if APU required for other procedures.

#### Main tank fuel pump u/s

(MEL-28-08 Sep 09)

1 may be inop. 120 mins rule

(N.B. with 120 mins rule can make crossing, provided make a northerly route over Goose and BGSF and BIKF WXR's are OK)

#### Engine Anti-Ice Systems u/s

(MEL-30-09 Jun 10)

No dispatch ETOPS, otherwise 120 mins rule.

#### Lower Cargo Compartment Fire Extinguisher Bottle 2B & 2C u/s

(MEL-26-33 Jun 10)

1 u/s: 120 mins rule. 2 u/s: 60 mins rule

#### Fuel Qty Indications / Total Fuel Qty Indication u/s

(MEL-28-35 / MEL-28-42 Jun 10)

180 mins rule.

#### Cabin Temperature Controllers u/s

(MEL-21-96 Jun 10)

1 u/s: 60 mins rule. Maintain F350 or below for cruise, (Except G-YMMR – MMU and 777-300ER aircraft).

#### Engine Driven Generator Systems (IDG, GCB) u/s

(MEL-24-06 Jun 10)

180 mins rule. (APU required)

#### ENG BLEED PRECOOLER u/s

(MEL-36-19 Sep 09)

Increase eng inop ETPOS Critical Fuel Reserves by 1.3% when dispatching into icing conditions.

#### Some A/T problems

(MEL-22-14 et al Sep 09)

180 mins rule.

#### SATCOM / (Datalink) System u/s

(MEL-23-09 / MEL-23-14 Sep 09)

180 mins rule. ADS not available on North Atlantic.

**Dispatch Defn**

(MEL 09-00-00-02 Sep 03)

Dispatched when a/c moves under its own power.

*After dispatch* any performance restrictions do not apply, nor do MEL Main Base restrictions apply if leaving main base, but check them anyway.

**No ACARS on ground**

(CJ)

- ❖ Try switching centre radio from ACARS to VHF or if Centre radio suspect try...
- ❖ Centre CDU → MENU → SATCOM → Call priority (1R) → Set to HIGH.

The tech reason is that by selecting HIGH priority the system automatically uses the right VHF radio if any problems with the centre VHF.

**O2 Min Dispatch**

(MEL-35-02 Sep 09)

Normal pre-flt 1600psi. (Crew/PAX)

(FCOM1 NP-30-10 Mar 09)

**Min Crew O2**

(MEL-35-04 Sep 09)

- ❖ 2 crew: 900 psi
- ❖ 3 crew: 1300 psi
- ❖ 4 crew: 1600 psi
- ❖ Min Ex UK: 1400 psi, except if 4 crew: 1600 psi
- ❖

**Min PAX O2**

(MEL 09-01-35-08 Sep 03)

- ❖ 300—400 PAX & 15 crew: 1600 psi
- ❖ 200—300 PAX & 15 crew: 1400 psi (Normally we have 216/220/224/272 or 280 seat a/c. Max is 280. See Sectn 13).
- ❖ <200 PAX & 15 crew: 1000 psi

**Replenishing Oxygen**

- ❖ No refuelling when O<sub>2</sub> is being replenished.
- ❖ No PAX on board when O<sub>2</sub> is being replenished.

(A[1] 2.14.6 Jun 08)

(A[1] 3.3 Jun 08)

**Un-pressurised Flights**

(A[1] 8.12.5 Jun 08)

- ❖ Flt management approval only
- ❖ Revenue flts limited to cabin altitude of 8000ft
- ❖ Non rev flights above 8000 only when:—
  - \* sufficient O<sub>2</sub> for flt above 10000ft
  - \* flt between cabin altitude of 18000 and 25000ft limited to 30 mins
  - \* max cabin altitude 25000ft
- ❖ Max rate of climb/descent, after obstacles cleared, 500fpm.
- ❖ Normal approach procedures but...
- ❖ See FCPM for other considerations.

**ATC Slot Times**

(A[1] 8.11.14.2 Jun 08)

- ❖ Euro slots (CTOT) have a 15 min tolerance of −5 to +10 mins.
- ❖ At LHR/LGW A/C should be at the holding point at CTOT −10 mins  
Elsewhere CTOT−5 mins



## 2 • Pre Flight to T/O & RTO

### Pre-Flight Checks

#### Pre Flt Checks and differences

(FCom1 SP-06-1 May 07)

- ❖ Electrical Power Up supplementary procedure required if electrics not established.
- ❖ Dummy IED call x27729.

(D R)

#### T/O Briefing

##### Emergencies

I (Capt) may stop, at my discretion, for any malfunction. (Normally for a Master Caution).

BEFORE V1: either of us can call STOP for the big 5 items:-

- Any FIRE warning,
- Eng failure, (confirmed by 2 or more parameters), inc **ENG FAIL L/R** warning.
- **CONFIG XXX** warning,
- A RAAS Runway Alert
- **'WINDSHEAR AHEAD'**, or (Inhibited 100kts—50R)
- **'MONITOR RADAR DISPLAY'** warning. (Inhibited 80kts—400R)

P2 to advise me (Capt) of any malfunction and if necessary I will call 'STOP'.

On the call of "STOP", I will close the thrust levers, disconnect the A/T and monitor the auto-braking above 85kts, manual braking below. Your actions will be.... (Select reverse idle, check brake deploys if not, deploy manually, above 80kts give you full reverse on both engines.)

I will bring the aircraft to a safe stop, set the parking brake, assess the situation, and call for any appropriate checklist. I will handle the RT and PA's as necessary. (If HWC turn toward eng failure).

AFTER V1 call **"Eng Failure"** or **"Eng Fire"**. Call **"Positive climb"** and gear up on my command. At 200 agl remind me to engage an A/P. Restate the emergency specifically. I will confirm the failure & call for the appropriate check list and you will ensure I monitor your recall actions. I will continue to fly the aircraft, follow the SID or emergency turn\* and clean up on schedule.

Actions for a fire...

At Vref30+80 & clean ensure CON displayed. Do the QRH then the After T/O Checklist.

At MSA select 5R for E/O climb speed.

With uncontained fire or smoke return to XYZ immediately (A/Land available?). Otherwise dump and return. Dump time....

Review. What's different about today...

- ❖ RR differences.
- ❖ 'A' market wts.
- ❖ 300ER diffs

\*Emergency turns: Tell ATC when making an Emergency Turn, as they may not be familiar with Company procedures.

(C/J)

RTO

#### RVSM Ops

(FCom1 L-10-2 Jun 09)

- ❖ On the ground, difference in either altimeter display and A/F elevation = 75ft max.
- ❖ The S/by altimeter does not count for RVSM as its not accurate enough.
- ❖ Prohibited if using Ldg Gear Extended ops.

## Engine Start

(FCom1 NP-30-29 May 07 et seq.)

### Auto Start (GE/RR)

(TM[FC2] 07-20-10 to 12 Apr 03)

- ❖ Auto start does not monitor oil pressure & temperature. It will take care of the following non-normals:
  - \* No EGT rise
  - \* No N1 Rotation
  - \* Hot start
  - \* Not enough starter air
  - \* Hung start
  - \* Starter fails
  - \* Compressor stall
  - \* Start time > duty cycle.
  - \* Starter shaft failure
- ❖ On the grnd, auto start, via EEC, will:–
  - \* make 3 attempts at starting a GE eng.
  - \* make 2 attempts at starting a RR eng, but this will be slow as it waits for EGT to cool to 100° before next attempt.
- ❖ On the grnd, EEC will not make a 2nd attempt for:–
  - \* No N1 Rotation
  - \* Not enough starter air
  - \* Starter shaft failure
  - \* Start time > duty cycle.

RR eng: oil temp indication only appears when eng start selected. Remains amber till the T/O min of 50°C.

Accomplish the ABORTED ENGINE START checklist if there is no oil pressure indication after EGT increases.

Delay start until pushback is nearly completed to save fuel / avoid load on tow bar.

Get the book out for these starts below...

### Grnd Air Start

(FCom1 SP-7-1 May 07)

- ❖ 3 Air carts required for grnd pneumatic start, 2 is the absolute min, but only if Autostart used.
- ❖ Duct pressure min 25psi (less 1psi/1000 PA). Duct press on SEC ENG display.

### X-Bleed Start

(FCom1 SP-7-2 May 07)

- ❖ APU must be off or APU bleed air OFF.
- ❖ Prohibited during push back.
- ❖ ENSURE CLEAR BEHIND.
- ❖ Increase N2/3 idle by 5%.

### Manual Start

(FCom1 SP-7-3 Jun 10)

	GE	RR
Timing	No time given	No time given
"Max Motoring"	N2 acceleration < 1% in 5 secs Oil P rise before selecting RUN	EGT < 100° & Max motoring or > 25% N3 Oil P rise before selecting RUN
Timing	EGT within 20 sec (2 spools)	EGT within 30 sec (3 spools)
Max EGT	Red Line (825°)	Red Line (700°)
N1 rotation by ...	50% N2	45% N3
Idle by...	N2 idle within 2 min of RUN	N3 idle within 2 min of RUN

(EGT temps from FMC maintenance pages)

### Eng Warm Up Requirements / Recommendations

(FCom1 NP-40-7 Jan 09)

RR Requirements:

- ❖ Engs off for > 1.5 hrs run eng for 5mins or more
- ❖ Engs off for < 1.5 hrs run eng for 3mins or more
- ❖ Use normal taxi power
- ❖ Eng oil temp above the lower amber band before T/O

GE Requirements:

- ❖ Eng oil temp above the bottom of the temp scale.

GE Recommendations:

- ❖ Run eng for 3mins or more
- ❖ Use normal taxi power



## Taxi

FCom1 NP-40-1 May 07)

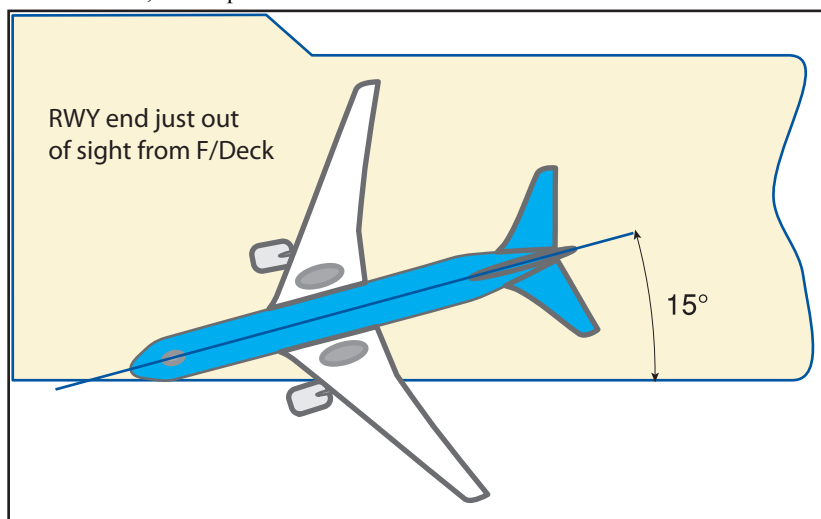
### Limitations for taxi

- ❖ Max taxi power:— 30% N1 in terminal areas, more as necessary away from ramp.
- ❖ Max taxi speeds, 90° turn:—10kts dry, 6kts wet, minimal in ice. (FCom1 NP-40-4 Jun 10)
- ❖ Max taxi speeds in ice:— 4kts.
- ❖ Main Gear Aft Axle steering activates when steering angle > 13° and < 20kts. Locks again at < 7°.
- ❖ Tiller can deflect nosewheel 70°, rudder pedals 7°.
- ❖ Allow aircraft to roll forward on runway to avoid T.O Config
- ❖ Tiller should not be used on T.O or above taxi speed on landing
- ❖ Taxiway C/L appears to go between PFD & ND.
- ❖ Taxi fuel burn:— 1800 kg/hr (600 kg/20min, 30 kg/min) (Typical cirrus)
- ❖ Taxi over 'Rigged & Up' cables – avoid doughnuts & max taxi speed is 25kts. (A[1] 8.13.3 Jun 08)

### Min Radius Turns (777-200 models)

(FCom1 NP-40-5 Jun 10)

- ❖ Check RIM for specific field procedures.
- ❖ Do NOT attempt turns on less than 180ft (55m) width pavement.
- ❖ Min width required for 180° turn = 156ft (47.5m).
- ❖ Approach RWY edge at 15° from RWY QDM & STOP when nearest pilot is sitting over edge markings. Nose wheel and O/B main wheels are now approx same distance from RWY edge. (Hence the required 15° angle, anything less will put the mainwheel in the grass!). This gives 2 to 3ft (1m) clearance from the markings. Ensure you are far enough into the corner to get round in the turning pan.
- ❖ Turn tiller to max angle. Release brakes & add thrust to outer eng (approx 45%). Keep speed low, 4—6kts. Max 10kts.
- ❖ Do not stop in turn.
- ❖ Differential braking is not recommended and does not reduce the turning circle.
- ❖ Nosewheel has the largest turning circle, and will leave pavement before main gear. If it is about to leave paved sfc, **STOP**. (Boeing notes)
- ❖ If pad available, turn into the pad. Best if Capt does RH turns, P2 does LH turns.
- ❖ Caution: wing travels outboard 5ft (1.5m) and 35ft (10.7m) beyond the nose. Do not attempt a turn away from an obstacle within 5ft (1.5m) of wing tip or 43ft (13.1m) of the nose. Note: wing span = 200ft (60.9m).
- ❖ Nose gear is 12ft (3.7m) behind pilot, main wheels 97ft (29.6m) behind pilot. Main gear approx 85 ft (26m) behind nose wheel.
- ❖ Tiller can deflect nosewheel 70°, rudder pedals 7°.



### Min Radius Turns (777-300ER models)

(FCom1 NP-40-6 Jun 10)

- ❖ Check RIM for specific field procedures.
- ❖ Do NOT attempt turns on less than 197ft (60m) width pavement.
- ❖ Min width required for 180° turn = 183.8ft (56.1m).
- ❖ Use GMCS to position main gear close to RWY edge.
- ❖ Technique as above, except angle is not specified (use a shallow angle)
- ❖ Significant turns (more than 30°) use 10kts or less - ensure speed does not decay in turn which might require significant extra thrust and possible blast damage.
- ❖ Caution: wing travels outboard 15ft (4.6m) and 24ft (7.3m) beyond the nose. Do not attempt a turn away from an obstacle within 15ft (4.6m) of wing tip or 39ft (11.9m) of the nose. Note: wing span = 212ft (64.8m).
- ❖ Nose gear is 12ft (3.7m) behind pilot, main wheels 114ft (34.8m) behind pilot. Main gear approx 102 ft (31m) behind nose wheel, which causes them to track inside the nose wheels during turns.
- ❖ 777-300 models have an extra 12 ¾ ft (3.9m) added to the wingspan. Total length has increased by 33ft (10m).

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**Shut down during remote holding**

(FCom1 NP-40-2 Jan 09)

Either or both engines may be shut down during delays.

Observe normal warm up times. (For less than 1½ hrs: 3 min warm up time required before T/O (covers both types). Check oil temps.

Under normal circumstances do not taxi with one engine when above max ldg wt.

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**Cabin Manager Comms**

Cabin Manager sits at 1L for T/O. Phone 11 and enter.

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**Holding Point**

A/C separated on approach by a TCAS difference of +/- 07 are approx 1 min apart.

(A[1] 8.3.20 Jun 08)

## Takeoff (T/O)

### T/O Limits.

(FCom1 L-10-1 Mar 03)

Max wind for taxi:	65 kts		
Max tail wind:	15 kts		
	<b>RWY State</b>	<b>X-Wind</b>	<b>Co-Pilot</b>
Max X-Winds:	Dry	40 kts (inc gusts)	26
	Wet ( $\geq 3$ mm Water)	25 kts	16
	Ice/Slush/Stdg Water ( $> 3$ mm)	15 kts	
	PVD	15 kts	

- ❖ Do not stop on HICL lights due possible damage to tyres due to heat.

(A[1] 2136 Jun 05)

### F/O T/O Limit

(A[1] 5.2.2.1.1 Jun 08)

- ❖ T/O - Min 600m RVR & cross wind limits of 2/3 A/C limits.
- ❖ Ldg - Min CAT 1 (or NP Approach) AOM & cross wind limits of 2/3 A/C limits.
- ❖ Pre-command under PICUS - normal Capt.'s limits. Capt.'s to read guidance in A[1] 5.2.0.4.1

### Hot & Hi A/F's

(FCom1 L-10-1 Mar 03)

- ❖ Max T/O Pressure Altitude 8400ft.
- ❖ Temp Inversion – If forecast or evident, **AND** temp is ISA + 15 or more, add 3°C to reported temp to calculate TOPL.  
(Clear calm conditions @ night). (PerfM. 3.2.2 Jun 99)
- ❖ S/Belt signs ON (rather than AUTO), till 10000 *agl*.
- ❖ Density altitude = A/F alt + 1000ft/8° above ISA. (FCOA 4, 6 Jun 01)

### Reduced Thrust

(PerfM. 3.2.6 Jun 00)

Reduced thrust NOT permitted when:–

- ❖ RWY defined as Slippery or contaminated with snow/slush/standing water,
- ❖ Significant windshear anticipated, (e.g. ATIS gives mod low level windshear or loss of 15kts – see windshear recognition Sec 11.47). (QRH MAN-1-12 May 07)
- ❖ Denver Bump used. (PerfM. 3.2.8 Jun 00)
- ❖ MEL/Performance Man.

### Packs OFF for T/O

(FCom1 SP-2-1 Jan 09)

- ❖ Select packs OFF at least 30 sec before T/O power is established, normally with 'Vital Data' check.  
When Packs selected off get **PACK L + R**. Cancel the EICAS msg. This means checklist will pop up when Checklist button pressed. (Rather than override checklist). (A Stewart)
- ❖ After T/O – reinstate packs after thrust reduced to CLB & prior to reaching 3000 aal.
- ❖ Ensure cabin pressure is stable before selecting second pack (good airmanship).
- ❖ EFATO – Reset packs on 1st power reduction i.e. after flaps UP. (A Stewart)

### A/C Operational T/O ban

- ❖ PPN covered RWY limits > 13mm (0.5") (Slush, Standing water, Wet Snow),  
> 60mm (2½") Dry Snow. (Tends to exist with OAT < -5°C)  
(Note: if temp > than -5°C, treat snow as slush, if unsure of type of snow).
- ❖ X-wind limits.
- ❖ MEL constraints.

### Climb Gradient

Rule of thumb to calculate required rate of climb is...Rate of climb (ft/min) = Gradient % x GS (kts)

### T/O with failed GPS

(TM[FC2] 11-40-44 Apr 03)

TOGA update at T/O becomes active. Enter any RWY pos shift required into FMC prior to T/O.

### T/O Unserviceable facilities

(A[1] 8.1.3.2.2d Jun 08)

If RWY lighting is partially u/s or RWY markings obscured refer to the table in A[1] 8.1.3.2.3, as modified by the State and shown on CARD. Under certain circumstances the Capt can elect to takeoff if the RWY is distinguishable from its surroundings. Stop end RVR may be substituted for Mid Point RVR.

**FCPM T/O ban**

(A[1] 8.1.3.2.2b Jun 08)

T/O banned if any of the following below limits:–

- ❖ RVR assessed from flt deck by Capt immediately before T/O.
- ❖ TDZ RVR or specified Met Vis. (Factoring not allowed for T/O).
- ❖ Note: Capt.'s assessment always overrides reported RVR / Met vis, except if not practical, i.e. humpy RWY or high RVR limit.
- ❖ Mid point RVR, when reported.
- ❖ Stop end, if specified by AOM notes (USA), or F/O PVD u/s, otherwise advisory only.
- ❖ Cloud Ceiling, if specified. (e.g. BOS RWY 22R: CLG 300ft).

Additionally, do not T/O if:–

- ❖ RWY is indistinguishable from its surroundings. (A[1] 8.1.3.2.2b Jun 08)
- ❖ At night with no RWY lights. (Min of RWY edge & end lights required). (A[1] 8.1.3.2.10 Jun 08)
- ❖ Condition of RWY. (A[1] 8.3.0.2.1 Jun 08)

If any lights u/s or markings obscured, see A[1] 8.1.3.2.3 [General] & 8.1.3.2.2 [State specific].

For USA/Canada refer to A[1] 8.1.3.2.2

**TDZ RVR not available for T/O.** Vis assessed by Capt. May takeoff if criteria for a ban above are exceeded [A[1] 8.1.3.2.2].

Factored met vis not to be used for T/O. (A[1] 8.1.3.2.2c Jun 08)

**T/O Config Warning (message CONFIG xxx)**

(TM[FC2] 15-20-10 Apr 03)

Siren and message when Fuel Control switches are in RUN, either eng in T/O range, and speed < V1 and either ...

- |  |                                |                           |
|--|--------------------------------|---------------------------|
| ❖ Flaps NOT in T/O position,                   | ❖ Park brake set,              |                           |
| ❖ Main gear steering not locked,               | ❖ Rudder trim not centred,     |                           |
| ❖ Speed brake lever NOT in DOWN detent,        | ❖ Stab trim not in green band. |                           |
| ❖ Door not closed/latch/locked.                |                                | (TM[FC2] 15-30-01 Apr 03) |
| ❖ ASR only required if RTO with T/O power set. |                                | (A[1] 11.3.2.2 Jun 08)    |

**[Tail Strike on T/O**

(QRH 15.3 Aug 03)

- ❖ Contact at 12° NU (wheels on RWY & struts extended). (FCom1 NP-50-2 May 07)
- ❖ DEPRESSURISE A/C,
- ❖ LAND AT NEAREST SUITABLE.
- ❖ Inspect A/C!!! ASR!!!!

**T/O X-Wind**

(A South)

Apply into wind aileron not greater than 2 divs, otherwise may crack the spoilers. Maintain wings level, normal rotation rate.

**T/O Windshear**

(FCom1 SP-16-22 Jun 09)

- ❖ Use **FULL T/O** thrust, if significant windshear anticipated. (e.g. ATIS gives mod low level windshear or loss of 15kts).
- ❖ Use 15° Flap unless performance limited, (Performance code 31).
- ❖ Use longest RWY into wind.
- ❖ Use the speed trend vector as a guide during T/O.
- ❖ Select FPV as a guide. (Needs to be above the horizon).
- ❖ Target Attitude 15°. But do not go below stick shaker. Control column forces are higher below the trim speed and get heavier towards the stick shaker.
- ❖ The PLI is the max pitch angle.
- ❖ Windshear before V1 — STOP.
  - \* If no room to STOP, full power, rotate normally at least 2000ft (600m) before the end of RWY, even if airspeed is low. Expect higher than normal attitudes to lift off in the remaining RWY.
- ❖ After V1 — apply full power, rotate normally to 15°. Once airborne – Windshear G/A, (leave gear down).
  - \* If performance is degraded & A/C is descending, use a higher attitude – up to stick shake to avoid hitting terrain. Maintain until shear penetration is complete. N.B. Reducing attitude to increase speed results in v. large rates of descent.
  - \* During T/O NHP should monitor vertical flt path. Call off the sink rate, speeds, and altitudes. Monitor rad alt.
  - \* Do not change config until grnd contact no longer a factor.
- ❖ Below 1000R, Windshear identified by changes of 15kts IAS, 500fpm RoD, 5° Pitch, 1 dot G/S deviation.
- ❖ In USA - Permissible to fly at turbulence speed below 10000ft. Advise ATC.
- ❖ Usual error during T/O with windshear/X-wind is to rotate too fast.
- ❖ If very strong HWC, may reach 80kts before power is fully set, and A/T have gone to HOLD.

**T/O - Terrain Constrained Departure**

(FCOM1 SP-42-1 May 07)

Need to constrain speed to Vref30+40, F5, use HDG SEL and 25° BANK.

Check Flap/Acceleration Hts, EO Aa, & Thrust Reduction Ht in FMC T/O Ref page.

Only known example is San Jose.

**T/O - Criteria for RTOW charts**

(PerfM. 3-3-5 Feb 97)

- |         |  |
|---------|--|
| Dry RWY | No reverse assumed for stopping case,<br>35ft screen Ht.                                   |
| Wet RWY | Reduced V1<br>Reverse on 1 eng assumed, penalty if reverser locked out.<br>15ft screen Ht. |

**T/O - Wet RWY (<3mm water)**

(PerfM. 5.1.5)

- ❖ Defn: <3mm water & friction coefficient approx ½ dry RWY, B/Action good. T/O wts based on wet RWY – only V<sub>1</sub> changes.
- ❖ Reduce V<sub>1</sub>
- ❖ X-wind limit 25kts.

**T/O - Contaminated (PPN Covered) RWY**

(FCOM1 SP-16-6 May 07)

- ❖ Max depth Wet Snow/Slush/Standing water = 13 mm (½").
- ❖ Max depth Dry Snow = 60 mm (2½").
- ❖ Must have T/O Altn if RWY slippery.
- ❖ Personal inspection advised.
- ❖ EAI ON for T/O (except with TAT > 10°C).
- ❖ Max X-Wind 15kt.
- ❖ All stopping devices must be serviceable, (i.e. Brakes/Anti-Skid/Spoilers/Reversers OK).
- ❖ Reduced Thrust T/O not permitted.
- ❖ Tail Wind T/O not permitted.
- ❖ Fuel tankering not permitted.
- ❖ Consider nature of over-run, WXR changes since last report, & potential consequences of overrun.
- ❖ Use max RWY distance available.
- ❖ Visual guidance for T/O – RWY edge lights or markings and/or C/L lights, or markings.
- ❖ Min cleared RWY width = 150ft (45m), symmetrical with the C/L.
- ❖ Cat 2/3 Pub RWY width must not be reduced by snow banks. Max snow bank at RWY edge not >2.5ft.
- ❖ If OAT > -5, treat snow as slush. Snow + slush = slush.
- ❖ Snow banks. (See Ice/Rain Section).
- ❖ CARD use only one code for Contaminated RWY with quoted braking actions.

(PerfM. 5.1.5)

**T/O - Degraded Braking Action**

- ❖ Medium or worse B/Action, but not contaminated.
- ❖ Must have T/O Altn if RWY slippery.
- ❖ If contaminated use most restrictive data.
- ❖ If have contaminated RWY and B/Action report, use the contaminated code for the CARD performance calcs. (This already assumes a B/Action and can only use 1 number).

**Assumptions**

- \* No deficiencies to braking system.
- \* Over speed T/O's not permitted.
- \* B/Action applies to whole of length of RWY, especially where RTO may be expected.

**Arrester cables**

(A[1] 2895 Jun 05 / FCOA: 4 Apr 06)

- ❖ Require T/O performance figures for the reduced TORA & ASDA.
- ❖ Inspect ldg gear for damage during 'walkround' if previous ldg was over cables.
- ❖ Approach cable must be "Rigged & Down". In this case, no speed restriction crossing cable.
- ❖ During T/O, expect to cross the approach cable ("Rigged & Down") at low speed & be airborne by the overrun cable ("Rigged & Up").
- ❖ When taxiing over a "Rigged & Up" cable, avoid nosewheel striking rubber doughnuts and not greater than 25kts.

## Rejected Takeoff (RTO)

(QRH MAN-1-2 May 07; A[1] 8.11.10 Jun 08)

### RTO handling

HP	NHP
“STOP” Close T/Levers, Disconnect A/T Remove hands from T/Levers Monitor A/Brake (active @ 85kts)... ...if not: Max wheel braking	“ENGINE FAIL”  Reverse Interlock Check speedbrakes Max available reverse (> 80kts) Note speed (G/S) Call speeds in deceleration (60kts)
Capt takes control at safe taxi speed “I have control” <i>(After reverse is cancelled is a good time)</i>	
Make a ‘safe’ stop (Consider: turn a/c into any fire – HWC turn a/c away from fire – TWC)  Parking brake ON Assess the situation “Identify Failure” Confirm failure – check annunciations. “Fire Engine L/R checklist” for any shutdown  “Mayday”	“Fire Engine L/R” or other failure  “Fire Engine L/R checklist” Action checklist
RT – check with tower for fire – open window PA (See below) Any emergency vehicle on freq. (LHR fire service 121.6)	
Evacuation Required?? No: PA “Pax & crew remain seated & await further instructions”. Taxi clear Yes: call for procedure... “EMERGENCY EVACUATION” <i>(ensures all know what is intended)</i>	
Consult brake energy chart: QRH PI-11-8 / PI-21-8 / PI-41-8	

#### STOP for:–

(QRH MAN-1-2 May 07)

Capt anytime:– Any significant failure or master caution, (most cautions inhibited @ 80kts).

(A Stewart / R Izon)

Either pilot, before V1:–

- Any FIRE warning,
- Eng failure, (2 or more parameters), inc **ENG FAIL L/R** warning.
- **CONFIG XXX** warning,
- A RAAS Runway Alert
- ‘WINDSHEAR AHEAD’, or (Inhibited 100kts—50R)
- ‘MONITOR RADAR DISPLAY’ warning. (Inhibited 80kts—400R)

Capt: Any other multiple failures / external factors.

F/O: Blocked RWY, or Significant handling difficulty.

After stop – R/T call “BA 123, MAYDAY, STOPPING”

(CAP 413 / J Potter / R Izon)

An RTO at V1 on a limiting RWY is a most critical manoeuvre. This puts the emphasis on taking the problem into the air rather than stopping in this limited case. (Check seniority numbers before making a decision:–)

Cabin Crew must initially remain fastened in their crew seats unless informed otherwise by the Flight Crew and should refrain from using the interphone except for urgent or safety related calls.

(A[1] 8.11.4 Jan 10)

Capt to make an PA as soon as practicable if evac not required, “Pax &amp; crew remain seated &amp; await further instructions”.

Once conditions have stabilised, the Captain will brief the SCCM by interphone &amp; explain to the passengers what has happened.

Alternatively, this may be delegated to the SCCM.

(QRH MAN-1-2 May 07)

- Section: 2.9



## Emergency Passenger Evacuation

(QRH Backcover 2 Jun 09)

Capt	F/O
Try for visual inspection...	
Call "PASSENGER EVACUATION"	Stop other checklists
Parking brake .....SET	Outflow switches (both) .....MAN
Fuel Control Switches .....CUTOFF	Outflow Valve Manual switches (both).....OPEN
Initiate Evacuation –	Eng Fire switches ..... PULL
"THIS IS AN EMERGENCY, EVACUATE, EVACUATE"	rotate if required
(Use PA btn on station box)	(May have to over-ride fire handle)
Additionally... "HAZARD AT ....."	Do not pull Eng Fire switches before Fuel Control Switches are Cutoff.
Initiate Evac Alarm	APU Fire switches ..... PULL
(reset station box to Comm 1)	rotate if required
INFORM ATC / Ground crew	

- ❖ Eng fire: Consider turn towards any fire if HWC. (A[1] 8.11.10 Jan 10)
- ❖ Try for vis inspection prior to evacuation, open DV window.
- ❖ Discharge Eng Fire bottles only when: (FCN 15/04 Aug 04)
  - \* A/C leaves/about to leave paved area – fire a bottle into each eng, (rotate handles in opposite direction – override fire handle in this case).
  - \* **FIRE ENG L/R** – fire both bottles into the burning eng, (rotate one handle both ways).
  - \* **FIRE APU** – fire bottle (rotate in either direction).
- ❖ Only discharge APU fire bottle if APU fire suspected.
- ❖ Leave the burning ship!!!!
- ❖
- ❖ If Cargo Hold fire/smoke – evac a/c (normally or via slides) before holds are opened by fire crew.
- ❖ Stay on RWY to allow access by emergency services.
- ❖ If evac not required, fire service to follow to ramp. (A[1] Nov 04)
- ❖ Cabin crew can initiate evac for: (A[2] 4.6.2 Jul 09)
  - \* Catastrophic situation exists following A/C accident where pilots have been incapacitated or
  - \* Physical conditions inside the cabin are unmanageable with extreme & immediate risk to life.

## Precautionary Rapid Disembarkation

(A[2] 4.10.1 Dec 08)

- ❖ Standard call "SCCM to the flt deck" – NITS.
- ❖ Capt (or SCCM if no pilots) makes PA. PAX to leave personal items behind. (A[2] 9.5.1.10 Jun 08)
- ❖ Disembark PAX by nearest door(s).
- ❖ Do not use EVAC alarm. Don't need to take emergency equipment, e.g. 1st aid.
- ❖ If evacuated to the apron/taxiway, a cabin crew member, with tabard, should accompany the PAX, and also take the megaphone for crowd control. Mobile phones should not be used by anyone. Move PAX to safe area.
- ❖ Fuel spill: PAX should be upwind/upslope and 15m (50ft) from any spillage. (200m for a BT on Grd). (A[2] 9.5.1.7 Dec 08)
- ❖



## Return to Stand

Some thoughts when returning to stand:–

- ❖ Control to F/O.
- ❖ Stop A/C.
- ❖ Diagnose – QRH – MEL – Company – Tango Tech.
- ❖ Advise Cabin Manager – PAX.
- ❖ ATC Taxi Instructions.
- ❖ Company – new stand No.
- ❖ “After landing checks”
- ❖
- ❖ On stand (Doors to Man x-check), (especially if towed in).
- ❖ Park Brake & Chox.
- ❖ “Shut down checks”,
- ❖ PA every 15-20 mins.
- ❖
- ❖ Refuel (review destination WXR),
- ❖ Tech log.
- ❖ Loadsheet, (If didn't T/O, do we need a new loadsheet - to check please).
- ❖ Departure WXR monitor, anti-icing? change of RWY, Wet/Dry RWY.
- ❖ New wts - update performance,
- ❖ Activate Flt plan,
- ❖ ASR – Tech Log Sign.

(L & B 5-8-1 Mar 95)



# 3 • Climb

## Optimum CLB speeds

(FCom1 NP-60-2 Jun 09)

- ❖ Max angle of Clb = FMC or M0.80 (Actually  $V_{ref30} + 80/M0.80$ )
- ❖ Max Rate of Clb = FMC + 50 or M0.83 (Actually  $V_{ref30} + 130/M0.83$ )
- ❖ If no FMC: climb at 310/0.83 (250 below 10,000 as required)

Note: Maintain at least 15kts above Min Man speed when climbing through FL200 to prevent EICAS caution **AIRSPD LOW** msg.

## Max Altitude Capability

(A South / FCom1 NP-60-2 Jun 09)

- ❖ 620 –Wt (ISA) RR & B model. (e.g. 620 - 260t = FL360 max)
- ❖ 600 –Wt (ISA + 20) A model.

At max altitude have sufficient excess thrust for a 300fpm climb. Also have a 0.3g manoeuvre margin.

Optimum level approx 2000ft lower.



# 4 • Cruise

## Turbulence Penetration

(FCom1 SP-16-16 Jun 09)

- ❖ Turbulence penetration:–
  - ✱ At or above 25000ft: Mach 0.82 or 280kts whichever is the lower.
  - ✱ Below 25000ft: 270kts.
- ❖ Consider the FMC optimum altitude as the max alt in mod to severe turbulence.
- ❖ In severe turb: descend to preserve buffet margins. (4000ft below optimum is a good start).
- ❖ A/P recommended.
- ❖ If manual, fly ATTITUDE first, then smoothly & deliberately correct for altitude, speed, hdg. Adjust thrust levers to correct excessive speed/ red line limits. Trim A/C for turb penetration speeds.
- ❖ V/S is the recommended mode for clb or descent in severe turbulence as speed is controlled by A/T. (VNAV and FLCH controls speed with elevator during clb/descent - but uses A/T during cruise).
- ❖ In severe turb: [GE engs] – Start/Ignition CON. (FCom1 NP-60-5 Mar 08)
- ❖ Reduce to M0.82 in turbulence to prevent over speeds.
- ❖ Use speedbrakes without delay if the speed trend vector approaches Mmo, whilst power is reduced.
- ❖ A/T may be disconnected to prevent excessive thrust changes. (FCom1 SP-16-19 Jun 09)
- ❖ Avoid CB's by 20nm and above 30000ft do not climb over them, unless overflown well in the clear, (min 5000ft).
- ❖ Min speed = 15kts above min man speed when below M0.82 at all altitudes. (FCom1 L-10-2 Jun 09)

## RVSM (FL 290 – 410)

(FODN Jan 02 / FCOA Mar 01)

- ❖ Min Equipment:–
  - ✱ 1 × A/P, with height keeping facility
  - ✱ 1 × Transponder
  - ✱ 2 × Air Data Systems, i.e. altimeters
  - ✱ 1 × Alt Alert System
- ❖ On the ground: max allowable difference between main altimeters and A/F elevation = 75ft. (Standby altimeter is not RVSM capable). (FCom1 L-10-2 Jan 09)
- ❖ During the walk round, pay particular attention to ports, probes and surrounding fuselage.
- ❖ RVSM prohibited if gear down operation. (FCom1 L-10-2 Jan 09)
- ❖ Prior to entry, altimeters within ±200ft. Cross check regularly, with subscales.
- ❖ A/P engaged throughout, except to control height excursions over 150ft.
- ❖ Keep TCAS in TA/RA mode.
- ❖ Max V/S during climb/descent: 1000 fpm within 1000ft of cleared level.
- ❖ Min V/S is 500 fpm (TCAS only detects rates > 500 fpm).
- ❖ Deviations > 300ft – inform ATC and file MOR/ASR.
- ❖ Turn from assigned track with 15 nm offset & ±500ft separation.
- ❖ RVSM requires a serviceable ADIRU (no NAV ADIRU INERTIAL caution eicas msg). (FCom1 NP-60-6 May 07).
- ❖ Inform ATC if failure of Engine, Altimeter, auto height keeping, or other equipment that affects height keeping.
  - ✱ Descend to FL 285 or below OR climb to FL 420.
  - ✱ File ASR
- ❖ WXR avoidance > 10nm – turning N of track descend 300ft / turning S of track climb 300ft. (RIM NA p2 Jun 02)
- ❖ 'W' on flt plan. Do not file this if the a/c is not RVSM capable before departure. See MEL.

## MNPS (FL 285 – 420)

(FCom1 NP-60-6 May 07)

Approved to enter provided 2 out of 3 of the following:–

- ❖ ADIRU ( **NAV ADIRU INERTIAL** caution msg not displayed)
- ❖ FMC (FMC advisory msg not displayed)
- ❖ Altn Nav System

The GPS, FMC & ADIRU nav accuracy should be checked every hour. (Know symbols).

## FMC

Max Altitude on FMC increases by 100ft every 11 mins (for RR @ 230 tons), 1000ft takes approx 1½hrs.

## Cruise - Climb Break even point.

(FCom1 NP-60-5 Mar 08)

90 mins from TOD. 4000ft climb costs 200 kg.

## FMC entries

		0°		
N52 W010 = 5210N	N		E	N52 E010 = 5210E
N50 W150 = 50N50				N50 E160 = 50E60
				Equator
S50 W080 = 5080W				S50 E085 = 5085S
S40 W155 = 40W55	W		S	S40 E155 = 40S55

*Short hand method of lat long entry into FMC*

### Other things to do with the FMC

Add waypoint every 5°: **W075-5**  
 Track xxx° from present posn: **P/Pxxx**  
 Intersection of airway with J54: **XJ54**

## RVSM WXR Deviation Procedures

- ❖ Call “WXR deviation Required” (RIM NA p3)
- ❖ Get Clearance.
- ❖ If no Clearance then:–
  - \* Call 121.5/123.45 with intentions,
  - \* Monitor TCAS, pick up visual scanning.
  - \* All A/C lights on,
  - \* For Deviation < 10 nm maintain FL.
  - \* For Deviation > 10 nm           if Turn North descend 300ft.
  - if Turn South climb 300ft.
  - \* Be level at correct FL < 10 nm from Track.

## PA

If overhead rest facility fitted, use handset for PA rather than the audio selector box.

## Fuel

### Fuel Burn & Penalties

(FCom1 NP-60-4 Oct 08)

2000ft above optimum 1–2% increase.  
 2000ft below optimum  
 4000ft below optimum 4–5% increase  
 8000ft below optimum 12–15% increase  
 Cruise 0.01 above ECON 1–2% increase  
 Speeds above M0.84 increase burn significantly.

(A South)

### Fuel Policy

(A[1] 8.3.7.3 Jan 11)

Flight towards destn with less than Diversion + Reserve fuel possible provided:

- \* **Delay not known and EAT not received:** can reach at least 2 aerodromes at which landing is assured, with at least Reserve fuel remaining at touchdown; (2 independent runways within 2 hours flying time is equivalent to 2 aerodromes, provided ATC delays accounted for).
- \* **Max delay known, or an EAT received:** landing at destination is assured, with at least Reserve fuel remaining at touchdown.
- \* Use wx forecasts when more than 2 hours from the relevant aerodrome. Within 2 hours, use actual wx reports and trend info.

If you **may** land with less than RESERVE FUEL, make a ‘PAN’ call, reporting fuel remaining in minutes.

If you **will** land with less than RESERVE FUEL, make a ‘MAYDAY’ call, reporting fuel remaining in minutes.

In the USA, use the phrase “Minimum Fuel Advisory”. See AERAD Flight Information Supplement.

# 5 • Descent & Holding

## Descent

### Descent Profile

(FCom1 NP-50-13 Mar 03)

- ❖ Use  $\frac{1}{2}G/S \times 10 + 50$  for required rate of descent, correct for 3° profile.  
(Correct by 50fpm for every 0.2° change in profile. e.g. 2.8° =  $\frac{1}{2}G/S \times 10$ ).
- ❖ Slowing A/C – use 1 nm / 10kts, FMC based on 500fpm descent during deceleration.
- ❖ Gates at 10000, 30 nm 250kts, and 3000 12nm Vref+80,
- ❖ EAI decreases glide by approx 0.5°.
- ❖ Use the metric altimeter and divide by 100 to assess DTG. X refer to progress page & DME's.  
Selecting off path descent will give direct distance to touchdown, or selected point such as FAF. To answer the question: 'Are we going to be stable by the FAF?' Program the FAF required altitude AND speed.

	Altitude	Rates of Descent	
		Clean	Spd Brake
0.84/310 kts	> 10 000ft	2300	5300
250 kts	< 10 000ft	1400	3300
Vref30+80		1100	2300

- ❖ **Rate of descent.** Max 3000 fpm within 3000ft of MSA/SSA (A[1] 8.3.18.4 Jun 08)
- ❖ GPWS typically goes off @  $3 \times$  height in sink rate. i.e. @500R, 1500fpm 'sink rate'.
- ❖ Gear down limit 270kts. For drag purposes do not extend gear at > 200kts. (FCom1 NP-50-15 Mar 03)
- ❖ **SPEEDBRAKE EXTENDED** msg if:–
  - \* Flaps in Ldg posn and < 800R, OR
  - \* Thrust lever not closed.
- ❖ OK to use speed brakes even with flaps 30. This is a SESMA event but ASR not required. (R Izon)
- ❖ If you need speed brakes below 500R you are not stabilised – G/A!!!! (FCom1 NP-60-7 Mar 03)
- ❖ Fuel: holding beacon to touch down: 20 kgs per track mile to be flown (i.e. 20 x DTG) (JB)

### Landing Assured

(A[1] 8.3.7.3 Jan 11)

A landing is "assured" if the Captain is satisfied that ldg can be completed in the event of any deterioration in weather and plausible single failures of ground / airborne facilities (e.g. a downgrade of say CAT 3A to CAT 2).

## Holding

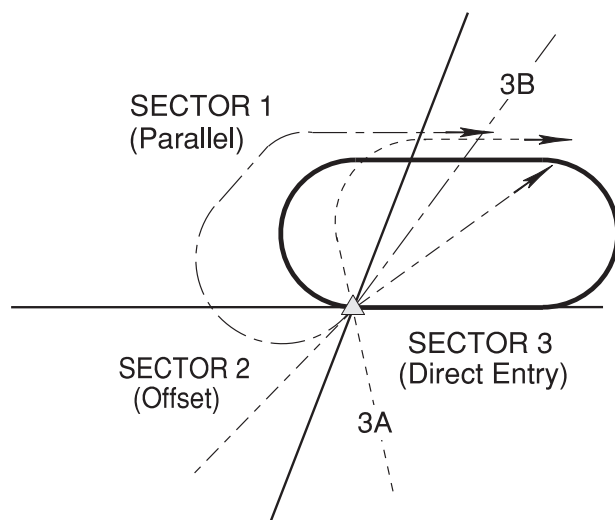
### Speed Cat

- ❖ 777 is Cat D.

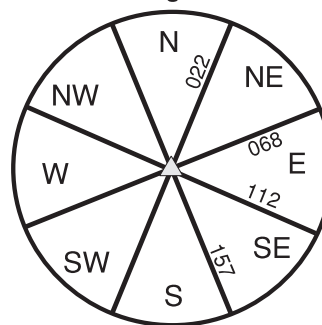
### Procedure Turns

- ❖ Enter procedure from  $\pm 30^\circ$  of out bound track.
- ❖ Timing starts at the beginning of the turn, 1m 15 sec for Cat C, D a/c.

### Holding Pattern



USA Holding Quadrants



- ❖ Entry Procedures determined by A/C HDG ( $\pm 5^\circ$ ), not TRK.
- ❖ Standard pattern is Right Hand. (USA use the phrase 'Standard pattern' to mean RH, and 'Non standard pattern' for LH pattern).
- ❖ Use  $25^\circ$  bank or  $3^\circ/\text{sec}$  turn whichever gives the smallest bank angle.
- ❖ Holding patterns are drawn at 200kts Still Air.
- ❖ Approach patterns are drawn at 180kts Still Air. (UK Air Pilot RAC 4-1-11)
- ❖ En route - Use 280kts for holds associated with airway.
- ❖ Reduce to hold speed at Fix -3 mins (USA). (FCom1 NP-60-1 Mar 03)
- ❖ EAT overhead beacon is -0 to +30 secs. (D S)
- ❖ In turbulence, ICAO max speeds for holding are: 280kts/M0.80 up to 34000, above 340, M0.83.
- ❖ 777 use 280/M0.82 above 25000ft, 270kts below 25000ft.
- ❖ Exceptions to ICAO - see individual county rules in supplement.
- ❖ In UK, phrase 'No delay expected' means not more than 20mins delay expected. EAT issued if longer than 20 mins hold expected.
- ❖ An EAT issued whilst holding en-route (e.g. MALBY) applies to the final holding fix (e.g. OCK). (3 Fleets Oct 03)
- ❖ I/Bound to LHR/LGW inform FT Dispatch (TOD - 45 min) if < 15mins holding fuel. FTD will deal with ATC regarding EAT swops. No discussion over Co Freq. (A[1] 8.3.1.8.9 Jun 08)
- ❖ Hold clean in Icing or turbulence conditions. (FCom1 NP-60-1 Mar 03)
- ❖ Hold at  $V_{ref30+80}$  = Best hold speed.
- ❖ Request 20nm legs, to save fuel.
- ❖ USA Holds:
  - \* If holding at defined fix, enter specified Quadrant/RADIAL into FMC. Quadrant not actually needed as FMC will sort that out. RH turns assumed. Hold toward fix. i.e. reciprocal of radial.
- ❖ Don't pre-program a hold whilst TRUE is selected.



**ICAO Max holding speeds (Cat C/D)**

(Flt Info Supp Rule 6 / FCom1 NP-60-1 Mar 03)

Altitude	777 Fleet	ICAO	London TMA	Outbound	Countries
Up to 14000 ft	FMC	230	220	1.0 Min	Bahrain, UAE HKG, India Holland, CIS, Saudi Arabia.
Above 140 to 200	FMC	240 (280 en-route)		1½ Min	
Above 200 to 340	240	265 (280 en-route)			
Above 340	250	M .83			
Above 400	M.82				

In turbulence, with ATC clearance, 280kt or M.80, up to 34000ft.

FMC holding speed:– Vref30 + 80.

**FAA Max holding speeds**

(W Hem Supp ATC 58 / FCom1 NP-60-3 Mar 03)

Altitude	FAA	As Published	Inbound	Countries
Min hold Altitude to 6000	200		1 Min	USA, Canada
Above 6000 to 14000	230	210		
Above 14000	265		1½ Min	

Note that timing is for the inbound leg. Initial hold should use outbound timing, then subsequent holds to be adjusted to achieve correct inbound timings.

**Holding Fuel Consumption**

- ❖ Holding at Flap 1, Vref30+60, uses approx 5% more fuel. (FCom1 NP-70-2 Mar 08)
- ❖ FF taken as 5500 kg/hr or 400 kg/hold, (GE85B, 200 tons, 10000ft)
- ❖ Typically 15mins in hold @ LHR uses 1 ton (accounts for descents).
- ❖ BNN to ldg approx 1 ton fuel. Min fuel to leave hold is RESERVE (2.8) + 1 ton (Approx 3.8 tons).
- ❖ Holding beacon to touch down:– 20 kgs per track mile to be flown (i.e. 20 x DTG) (J B)

**FMC Holding**

(FCom1 NP-60-1 Mar 03)

- ❖ **To set up a hold in FMC, the holding fix must be in LEGS page first.**
- ❖ Don't pre-program a hold whilst TRUE is selected.
- ❖ Hold at Vref30+80 = Best hold speed.  
(FMC Hold page @ 5R = Best hold speed at present A/C config.).  
(FMC Hold page @ 1R = Best hold speed, Flaps UP, at hold target altitude).
- ❖ If operating asymmetric, selecting ENG OUT (5R) will enter correct cruise speeds into FMC and aid hold entry at correct speed.
- ❖ FMC Hold entry.
  - \* Function of A/C track as fix is crossed. (FCN 07/01)
  - \* Initial o/bnd leg maintained for a fixed distance, (not time). Distance is a function of airspeed & wind as hold becomes active.
  - \* Teardrop entries use 40° angle.
  - \* Parallel & teardrop entries may take A/C beyond displayed hold but remains inside protected area.
- ❖ Enter in the estimated best hold speed in the LEGS page as part of the VNAV profile. This will update the speed at 1R SPD/TGT ALT on the hold page or can enter the speed here as well. This will automatically draw the hold at the correct speed. Hold is redrawn each time it passes over the beacon.
- ❖ At the end of the outbound leg, if press EXIT, FMC will continue in hold until next time over beacon.
- ❖ **En-Route Holding:** To hold in present posn on an airway use the PPOS prompt 6R on LEGS page after HOLD btn selected. (TM[FC2] 11-43-28 Apr 03)



# 6 • Approach & Landing

## Approach Phase

### Landing Limits

(FCom1 L-10-1 Mar 03)

#### Autoland

Max Wind	Autoland	25 kts
Max X-Winds	Autoland	25 kts (15 kts USA)
Max tail wind	Autoland	15 kts.

#### Manual land

Max X-Winds	Dry	40 kts (No gusts)
Max X-Winds	Wet	40 (≥ 3mm Water)
Max X-Winds	Icy/Slush/Standing Water	15 (> 3mm Snow/Slush/Water)
Max tail wind		15 kts.
Max tail wind	Slippery (μ = .05)	5 kts (BOTH REVERSE & see Ldg Data).

#### F/O limits

(A[1] 5.2.2.1.1 Jun 08)

T/O - Min 600m RVR & cross wind limits of 2/3 A/C limits.

Ldg - Min CAT 1 (or NP Approach) AOM & cross wind limits of 2/3 A/C limits.

Capt. 's to read guidance in A[1] 5.2.0.4.

Pre-command under PICUS - normal Capt. 's limits.

### Pitch & Power Settings

(FTSG 03-01-03 Dec 96)

Flap	Phase	Tgt Speed	Attitude	N1 GE	N1 SE GE	EPR RR	EPR SE RR
Up	Cruise	M.83 - M.85	2	83%		1.16	
Up	Drift Down	250 - 340	0		MCT		MCT
Up	Hold	Vref30+80	4 ½	55%	70%		
1		Vref30+60	6				
5	Base	Vref30+40	5	56%	71%	1.050	1.150
15	LOC	Vref30+20	6	58%	73%	1.067	1.167
20	LOC + Gr	Vref30+20	4 ½	62%	77%	1.107	
20 E/O	G/S + Gr	Vref20+5	2 ½		62%		1.09
30**	G/S + Gr	Vref30+5	1 ½	58%	(78%)	1.07	(1.20)

- ❖ Based on 200 tons. Vref30 = 135, bug = 140 = F20 V2.
- ❖ F20 SE T/down speed = Vref30+17 = F5 V2.
- ❖ Rudder trim for SE work approx equals the pitch required, except for F30 Ldg.  
\*\*Note: SE F30 Ldg, only if ldg dist is critical and check G/A case in QRH PI-13-11 et seq.
- ❖ Easy numbers to remember are 3/6/10/12, (descent/level/derated thrust climb/G/A power).
- ❖ Difference between 2 eng & SE work approx 15% N1 (GE) or 0.1 EPR (RR).
- ❖ NHP call "Attitude" at 7½°. Tail strike @ 10°; wing tip / LE flaps strike if roll > 10°.

(FCom1 NP-60-11 Mar 03)

### TOD – 10mins / FMC Profile

(FCom1 NP-50-10 Mar 03)

- ❖ Brief.
- ❖ Delete any man tuned ILS.
- ❖ GPS updating - both P1 & P2 can use ND map display.

#### FMC

(TM[FC2] 11-20-10 Apr 03)

- ❖ ILS auto tunes when the ILS is part of active route **and...**
  - \* A/C < 50nm from TOD OR
  - \* A/C < 150nm from Ldg threshold OR
  - \* FMC in the descent mod

## Descent Profile

(FCom1 NP-60-10 Mxx 09)

- ❖ Use  $\frac{1}{2}G/S \times 10 + 50$  for required rate of descent, correct for 3° profile.  
(Correct by 50fpm for every 0.2° change in profile. e.g. 2.8° =  $\frac{1}{2}G/S \times 10$ ).
- ❖ Slowing A/C – use 1 nm / 10kts, FMC based on 500fpm descent during deceleration.
- ❖ Gates at 10000, 30 nm 250kts, and 3000 12nm Vref+80,
- ❖ EAI decreases glide by approx 0.5°.
- ❖ Use the metric altimeter and divide by 100 to assess DTG. X refer to progress page & DME's.  
Selecting off path descent will give direct distance to touchdown, or selected point such as FAF. To answer the question: 'Are we going to be stable by the FAF?' Program the FAF required altitude AND speed.

	Altitude	Rates of Descent	
		Clean	Spd Brake
0.84/310 kts	> 10 000ft	2300	5300
250 kts	< 10 000ft	1400	3300
Vref30+80		1100	2300

- ❖ **Rate of descent.** Max 3000 fpm within 3000ft of MSA/SSA (A[1] 8.3.18.4 Jun 08)
- ❖ GPWS typically goes off @  $3 \times$  height in sink rate. i.e. @500R, 1500fpm 'sink rate'.
- ❖ Gear down limit 270kts. For drag purposes do not extend gear at > 200kts. (FCom1 NP-60-16 Jun 09)
- ❖ **SPEEDBRAKE EXTENDED** msg if:–
  - \* Flaps in Ldg posn and < 800R, OR
  - \* Thrust lever not closed.
- ❖ OK to use speed brakes even with flaps 30. This is a SESMA event but ASR not required. (R Izon)
- ❖ If you need speed brakes below 500R you are not stabilised – G/A!!!! (FCom1 NP-60-7 Mar 03)
- ❖ Fuel: holding beacon to touch down: 20 kgs per track mile to be flown (i.e. 20 x DTG) (J B)

## Instrument Approach Ban

(A[1] 8.1.3.2.12.3 Jun 08)

See section 7 'AWOPS &amp; AOM'

## Landing Flap

(FCom1 NP-70-5 Mar 10)

- ❖ For a **manual ldg**, normally use F25 (can also be used on wet RWY). Flap 25 AUTOLAND **not permitted**.
- ❖ For –300 see perf manual. For –200 & –200ER, F30 must be used if:
  - \* LDA < 2100m + 50m / kt TWC
  - \* Elevation > 1500 ft
  - \* Any abnormalities: braking deficiency, increased Vref, LDG perf penalty, MEL or CDL item
  - \* Braking action < GOOD or RWY contaminated.
- ❖ Extending flaps to F30 above Vref30+20 may cause flap load relief and subsequent thrust changes.

## Normal Approach Profile

(FCom1 NP-70-5 May 07)

- ❖ Normally extend flap to next setting at max of 20kts above the min for the current setting.
- ❖ Established when within 1 dot LOC.
- ❖ Max LOC intercept angle 120°.
- ❖ Change of RWY – when < 1500R, with either LOC or G/S engaged, can only retune ILS by disengaging A/P AND F/D.
- ❖ Extend gear @ 2000R (& not later than 1500R), Ldg flap by 1000R.
- ❖ Approaching G/S intercept:  $1\frac{1}{2}$  dots fly up  $\approx$  2nm to G/S, 1 dot  $\approx$  0.35°, 1.3 nm to G/S.
- ❖ 6\* on the interphone inhibited < 800R. (FCom1 NP70.3 )
- ❖ When visual, can cancel the "50 Above" & "Decide" calls by pushing minimums RST btn.
- ❖ G/S alive: "Gear Down Flaps 20"
- ❖ G/S Capture: "Flap 25"; Vref + 5 (Load relief if > Vref +20).
- ❖ Below 100R not more than 1000fpm.
- ❖ If required, both F/D's should be off for vis approaches – but NHP may use F/D provided LOC & G/S engaged.
- ❖ **G/A if speed over threshold is > Vref30 +15 on a limiting RWY.** (FCom1 NP-70-9 May 07)

## Approach Speed Limitations

(FCom1 NP-70-7 May 07)

- ❖ With A/T engaged use Vref+5. No additional wind correction required as A/T gives gust protection.
- ❖ With Manual thrust levers (A/T out) use:–
  - \* Target Threshold Speed = Vref +  $\frac{1}{2}$  HWC + full gust factor, (max of 20kt increment).
  - Max approach speed (500R) = TTS + 20kts
  - Min approach speed = Vref + 5kts
  - \* Threshold speed = Vref + gust (Bleed off the steady state part with a min of Vref+5)
  - Max over threshold = Vref + 15kts
- ❖ **G/A if speed over threshold is > Vref30 +15 on a limiting RWY.** (FCom1 NP-70-9 May 07)
- ❖ Vref30 changes by  $3\frac{1}{2}$  kts for every 10 tons.
- ❖ Non Normals: add same corrections to c/list Vref. i.e. Vref30+20+5 (A/T) or Vref30+20+Wind correction (No A/T)

**Speed Relations**

(FCom1 NP-60-5 Mar 03)

<b>Flap 0 (Up)</b>	Vref30 + 80	<b>Flap 20</b>	Vref30 + 20
<b>Flap 1</b>	Vref30 + 60	<b>Flap 25</b>	Vref30 + 5
<b>Flap 5</b>	Vref30 + 40	<b>Flap 30</b>	Vref30
<b>Flap 15</b>	Vref30 + 20		

250kts IAS v TAS v ISA Temp (Density Altitude, DA= A/F Alt + 110ft/° above ISA. 1013 assumed)

(FCOA 4)

Temp	TAS @ PA 5000ft (ISA = 5°)	TAS @ PA 10000ft (ISA = - 4.8°)
ISA -20	258 (DA 2510ft)	277 (DA 7500ft)
ISA -10	262 (DA 3780ft)	282 (DA 8770ft)
ISA	267	288
ISA +10	272 (DA 6160ft)	293 (DA 11150ft)
ISA +20	277 (DA 7270ft)	299 (DA 12250ft)
ISA +30	282 (DA 8340ft)	304 (DA 13320ft)

**Descent & Approach (FCPM)**

(A[1] 8.3.18.2 Jun 08)

**Requirements for descent below MSA in IMC, and under radar**

(A[1] 8.3.18.2 Jun 08)

- \* no undue reliance on one navigation aid,
- \* descent permitted to relevant SSA (or MSA) within 25nm of A/F & in appropriate quadrant,
- \* descent to radar cleared altitude OK when under positive radar control:
  - Capt responsible for ensuring adequate obstacle clearance,
  - Capt to x-check initial radar posn & continue to monitor posn & SSA/MSA,
  - If in doubt about the Radar Cleared Altitude, climb to SSA/MSA.
- \* further descent permitted using a published instrument approach or arrival procedure.

**Requirements for descent below MSA in VMC to circling minima:-**

(A[1] 8.3.18.3 Jun 08)

- \* by day, clear of obstacles on intended track, (remaining clear of low cloud/fog),
- \* by night, as above and if line of sight is also line of flight, i.e. directly towards an identifiable lit area (in general the runway) and dist is checked against height.

**ILS Approach (FCPM)**

(A[1] 8.3.18.15.1 et al)

- ❖ LOC coverage varies from 25nm & ± 10° (minimum) to ± 35° (UK).
- ❖ Accuracy of G/S reduced outside ± 8° of LOC, hence... must be established before descending on the G/S.
- ❖ When carrying out an ILS approach, do not descend below the SSA except:-
  - \* by using an approved ILS Instrument Approach Procedure, or
  - \* when satisfied that position is under control by an approved radar unit, or
  - \* visually, ensuring clearance from all obstacles on the intended track.
- ❖ Do not use G/S as the sole means of descent guidance until localiser established & within 10nm from touch-down. When established on the G/S, do not descend below the half scale “fly up” indication.
- ❖ Rate of descent must be checked against pre-computed rate.
- ❖ With only one ILS receiver or a discrepancy between displays, make max use of other aids & complete all altitude checks on the approach chart. If the G/S indication cannot be verified and visual reference for landing not achieved – G/A.

**Stabilised Approach**

(A[1] 8.3.18.7 Dec 08)

**By 2000 aal:** Gear down. Avoid extending gear above 200kts, (increases gear life).

(FCom1 NP-70-7 Jan 09 / NP-60-16 Jun 09)

**Stabilised approach:-**

- ❖ in the planned ldg config
- ❖ approach power set
- ❖ on the correct vertical profile
- ❖ IAS not more than target threshold + 15kts (Vref+20)

**At 1000R: If criteria not met: seriously consider G/A. (Hi energy approach).**

Stabilised conditions must be maintained for rest of approach. ASR if not achieved!

Suggest that if you have only achieved 1 or 2 out of four criteria - you **must** go round! Safer to G/A now than at 500R. (Flt Ops News 26/28)**At 500R: If criteria not met: immediate G/A. ASR required. (Rushed approach).**

Note: Max rate of descent below 500ft = 1000 fpm.

(FCom: ?????)

**At 300R:** A/C must be aligned with RWY. Do not use visual approach aids, except PAPI's, below 300ft.**Below 200R:** Follow electronic G/S to 100R if available. No lateral corrections to be made. G/A if misaligned at this point.

(FCom1 NP-60-9 Mar 03)

How do you recognise windshear on approach if A/C not stabilised?

## Avoid High Energy Approaches

(Flt Ops News 26 &amp; 28)

- ❖ 1000ft SAC gate is a target, not a start point. File ASR if missed.
- ❖ The 777 is very clean & will not go down & slow down. Use the speedbrakes properly - i.e. full application until gate is assured. Normally takes 1nm to lose 10kts in level flight.
- ❖ Technically possible to use speedbrake with Ldg flap even though you get EICAS message.
- ❖ Gear down by 2000 ft AGL **at the very latest**, (note 200 kt restriction when extending).
- ❖ Visual approach platform is 1500ft to allow margin for a/c configuration by 1000ft.
- ❖ Monitor track miles to touchdown - use the meter switch on the altimeter to give 3nm/1000 guide & compare with Progress DTG.
- ❖ TWC? How will this affect energy requirements?
- ❖ Density altitude effects. Plan ahead. (Again, use the meter switch on the altimeter to give 3nm/1000 guide)
- ❖ Known problem A/Fs (DEN, ORD, MCO, NBO)
- ❖ US: once cleared for app, previous speed restrictions are cancelled unless applied with app clearance. Cancelled after the FAF/5nms.
- ❖ Finally, an approach terminated by G/A is NOT deemed to be a High Energy app.

## Visual Approaches

(A[1] 8.1.3.2.13.7 Jun 08 &amp; FCom1 NP-90-3 Mar 03)

- ❖ Use circling minima of 1000ft min. (Note any specified radius / sector). (Min met vis 3600m for planning purposes only)

### Visual reference requirements for an approach below circling minima or DA/H

- \* Before established on extended centre line: (A[1] 8.1.3.2.13.5 Jan 10)
  - sufficient visual reference of the terrain **and** either the approach lights or the runway itself must be continuously in view to ensure terrain clearance to extended c/line, (only exception is use of visual approach chart).
- \* On extended centre line: (A[1] 8.1.3.2.13.6 Jan 10)
  - sufficient approach or runway lighting or runway itself must be continuously in view.

Now possible to transit from circling to visual approach if full visual achieved by 1500ft AAL

(A[1] 8.1.3.2.13.7 Jan 10)

### Visual Approach Ban

(A[1] 8.1.3.2.13.3 Jan 10)

Do not descend below 1000ft aal or Circling min if this is higher, if:-

- \* TDZ RVR or visibility or factored Met vis < AOM. Assume 800m if min not quoted in AOM.
- \* Mid point < 125m
- \* Stop end < 125m (if reported and if specified in AOM).

### G/A USA (from Vis APP).

Do not follow G/A procedure for the instrument approach for that RWY.

G/A is straight ahead & request ATC instructions.

(RIM USA Brief)

If visual references lost whilst circling from an Instrument approach, use the MAP for the Instrument approach just flown. Make a climbing turn towards A/F to keep within the circling area, whilst climbing to MSA. Establish on the MAP course.

## Windshear Approach & Landing

(FCom1 SP-24-3 Mar 03)

- ❖ Compare ND wind with reported sfc wind.
- ❖ Stabilised by 1000R for improved windshear recognition.
- ❖ If A/T inop, max increment on approach +20kts. Max at threshold +15kts.
- ❖ Use FPA as a guide on approach. (N. McDowall)
- ❖ Below 1000R unacceptable flt path identified by uncontrollable changes in excess of: (QRH MAN-1-13 May 07)
  - \* 15 KIAS
  - \* 500fpm VSI
  - \* 5° pitch attitude
  - \* 1 dot displacement from G/S
  - \* T/Levers in unusual positions for significant time.
- ❖ In heavy rain / turbulence set the START/IGNITION switch to CON {GE engs only}. (FCom1 NP-50-6 Oct 04)
- ❖ Use longest and most suitable RWY.
- ❖ Brief for windshear. Exceptionally, in conditions of extreme turbulence associated with strong winds & NOT Cb or frontal activity, windshear warning can be treated as advisory provided warning is anticipated, briefed for and allowances made. (A[1] 8.3.8.3.1 Jun 08)
- ❖ Below 25000ft: 270kts turbulence penetration speed.
- ❖ Below 15000ft, with weight < max landing weight, 250kts clean will give adequate stall margins in severe turbulence.

## Know your vertical modes

- ❖ VNAV SPD controls speed with elevator. When A/T change to HOLD (after a short delay), manual thrust will control rate of descent and profile. As the path is not being followed automatically, use speed brake as required. If altitude constraint is reached prior to the associated waypoint, the A/C levels in VNAV PTH. On passing the waypoint the A/C recommences descent in VNAV SPD.
- ❖ FLCH gives direct control of speed through the MCP. There is no ALT protection. Monitor all speed/altitude gates to ensure A/C maintains the profile. The VNAV PTH pointer on the ND gives path deviation info.
- ❖ VERT SPD gives direct control of speed and ROD through the MCP. Like FLCH there is no protection to prevent deviation from the profile, so monitor closely (VNAV PTH pointer still available).

## Non-ILS (Raw Data) or NDB Non Precision Approach

(FCom1 SP-04-5 Mar 04)

- ❖ Use A/Pilot if available, otherwise DA= highest of circling min or 1000ft aal.
- ❖ If A/P not available, manually fly to NPA DH limits (AOM+50ft — see below). (R Izon)
- ❖ **Min altitude for VNAV is 3000ft aal**, except when using RNAV/RNP approach.
- ❖ Confirm GPS OK before approach.
- ❖ Manually tune VORs (prevents auto tuning) & enter required CRS. (CRS only available when man tuned.)
- ❖ All NPA's must be monitored with raw data. **Must ensure VOR/ADF needles are displayed!!!**
- ❖ Screen radio aids should be 'visually' identified. (There is no comparison with the FMC database – decoding can be wrong if station weak). (TM[FC2] 11-20-11 Apr 03)
- ❖ One to monitor ADF ident (audio or **visually**) throughout procedure. (A[1] 8.3.18.10.1 Jun 08)
- ❖ Can now pre-empt BCN passage in descent. IR tolerance is –70ft at BCN. (TJD)
- ❖ Establish landing config before FAF, if possible, to reduce workload. (FCN 05/08 Feb 08)
- ❖ Auto call “500” on NPA's. **If it occurs in the wrong place - G/A.** (CCF 25/03)

\*

## FMC Programming

(TM[FC2] 11-43-10 Apr 03)

- ❖ Program FMC MAP display & **profile**. Note: NDB's are NOT in FMC. No G/A in FMC either!!  
Enter descent point as ILS BRG/DIST or other waypoint or select RWY and enter RWY EXT fix.
- ❖ Using RWY EXT. Use dist from RWY not DME dist quoted. LNAV can be used if RWY QDM & final approach track are aligned and if FMC route is RXxx direct to RWxx. Cannot put FAF in between. Recommend put RX at the FAF posn & extend the route beyond using RX INT (6R) –ARR page only. Remove discontinuities either side of RX. Ensure RX is inside the final procedure turn otherwise pink string may turn the wrong way. (Use FAF to MAP dist on chart).
- ❖ Consider leaving a route discontinuity in legs page to stop pink string drawing line inside BCN.
- ❖ Set profile up with RX 140/ BCN Ht and RW 130/ Threshold + 50ft. (Note G/S angle in FMC legs).  
Enter RWY as 135/0090 for RWY with 40ft threshold height.
- ❖ Note: for pure FMC only approach - use same speed for both so an even profile is generated. (Phil Morley)
- ❖ Care needed when intercepting track inside the active waypoint, or if G/A with active waypoint behind you.
- ❖ No G/A is programmed if RWY EXT is used. Build G/A route so can engage LNAV @ 400R. Ensure any hold is built. Can only enter hold in FMC if the waypoint exists in the legs page.

## Display usage

(FCom1 SP-04-8 Mar 03)

App Type	GPS OK		GPS not OK			
			(Posn verified)		(Posn NOT verified)	
	HP	NHP	HP	NHP	HP	NHP
<b>ILS</b>	<b>MAP</b>	<b>MAP</b>	<b>MAP</b>	<b>MAP</b>	<b>APP</b>	<b>MAP</b>
<b>LLZ</b>			<b>APP</b>		<b>APP</b>	
<b>BB</b>			<b>APP</b>		<b>APP</b>	
<b>VOR (Man Tuned)</b>			<b>VOR</b>		<b>VOR</b>	
<b>NDB</b>			<b>APP**</b>		<b>APP**</b>	

- ❖ \*\*For NDB approach use APP with false ILS with required QDM.

GPS failure indicated by EICAS msg **GPS** or absence of GPS on MAP display.

- ❖ To verify posn use POS switch or 2 different DME's on FIX page.
- ❖ APP/VOR display (Expanded or Ctr):
- ❖ Use Expanded scale for accuracy,
- ❖ Use CTR scale for extra vision during turn.
- ❖ Note: on ND the HDG label always displayed. Hdg bug changes shape when TRK selected.
- ❖ Monitor VOR/ADF on ND but monitor LOC/BB on PFD.



## Lateral Navigation (Approach)

(FCom1 SP-04-5 Mar 03)

### Lateral Navigation (Intermediate Approach)

**Approach in FMC D/base** – use LNAV

**Approach NOT in FMC** – LNAV not allowed, load route & use HDG/TRK SEL with raw data.

Note: Tracking to or holding at a database fix is permitted in LNAV.

### Lateral Navigation (Final Approach)

**Approach in FMC D/base** – use LNAV

**Approach NOT in FMC:–**

- \* RWY QDM aligned – select RWY EXT & use LNAV.
- \* RWY not aligned – construct own procedure but do **not** use LNAV, use HDG/TRK SEL  
Use FIX page to draw inbound line or use false ILS.
- ❖ Use trend vector or tiger's tail to anticipate turn on to the QDM.  
At 90° with zero wind, turn at 1 tiger tail, (30 sec vector); with TWC, turn at 1.5 tiger tails.
- ❖ Use the FIX page to enter the bearing and range for any outbound segment of the approach.
- ❖ If not using the map, load false ILS & set APP mode on ND. For VOR approach use VOR and select required CRS. Once needles are aligned to correct QDM, put the white TRK line onto the magenta line.
- ❖ For Localiser approaches: use LOC mode.
- ❖ For VOR / NDB approaches: use HDG, TRK or LNAV. Do not use APP or LOC mode.
- ❖ Can deselect APP mode if above 1500ft. Below 1500ft – disconnect A/P & F/Ds OFF.

## Vertical Navigation (Pitch Modes)

(FCom1 SP-04-6 Mar 03)

- ❖ Use V/S or FPA, (Set V/S or FPA 000 to maintain altitude).  
1 click V/S  $\equiv \pm 100\text{fpm}$ : 1 click FPA  $\equiv \pm 0.1^\circ$  (25fpm), 5 clicks ( $\frac{1}{2}^\circ$ )  $\approx 125\text{fpm}$  change.  
High or low by 50'  $\rightarrow$  1 click on V/S ( $\approx 4$  clicks FPA).  
High or low by 100'  $\rightarrow$  2 clicks on V/S  
Hi / low 40'  $\approx \frac{1}{2}^\circ$ ; Hi / low 80'  $\approx 1^\circ$  correction required.
- ❖ Descent when within  $\pm 5^\circ$  of required track. This applies to any procedure, not just final approach.
- ❖ Rates of descent & altitudes v DME/time must be extracted/calculated and extrapolated back to ensure a continuous approach possible from last cleared altitude or FL. Include in briefing. Not required if VNAV used to fly approach and constraints/FPA checked. (A[1] 8.3.18.11 Jan 10)
- ❖ FAF verified by raw data.
- ❖ Disconnect A/P by 50ft below MDH. (Do not have to disconnect immediately at decision).
- ❖ Set MCP Alt out of way otherwise V/S will capture it, set G/A alt when descending >300ft below the G/A altitude.
- ❖ Call out heights at +20, +40, +60, +90 sec heights and give calls early.
- ❖ For a continuous descent: NHP/NLP to continue to call out DME altitudes after the handover.
- ❖ In the briefing, check RWY length and lighting. If no VASIS then will need height checks after DA.
- ❖ If WXR on limits & reach DH too early to see RWY - G/A. Cannot fly level.
- ❖ Always fly a G/A through the MAP for obstacle clearance purposes.
- ❖ F/D's both off when visual & no longer using them for guidance. On a G/A, remember to put them back on!  
When F/D's are off – expected to use FPV. (Mike Thrower)
- ❖ Think about a mental picture of the RWY when visual. What G/S angle is the NPA. Will you be high/low compared with a standard 3° slope? Is the approach offset, and how will this affect the visual picture with a X-wind?

## Back Beam Approach

(FCom1 SP-04-5 Mar 03)

- ❖ Do not use MCP LOC, will not capture. Indications are good but the A/P will fly it incorrectly.
- ❖ Most BB approaches in FMC – so use LNAV.
- ❖ If BB not in FMC d/base, insert ILS front course QDM into RAD NAV page.
- ❖ Inhibit G/S (modified a/c only). There are two types of inhibit switch; one only works <1000R.

## G/A

(FCom1 SP-04-6 Mar 03)

For non-database approaches: no G/A is available in FMC.

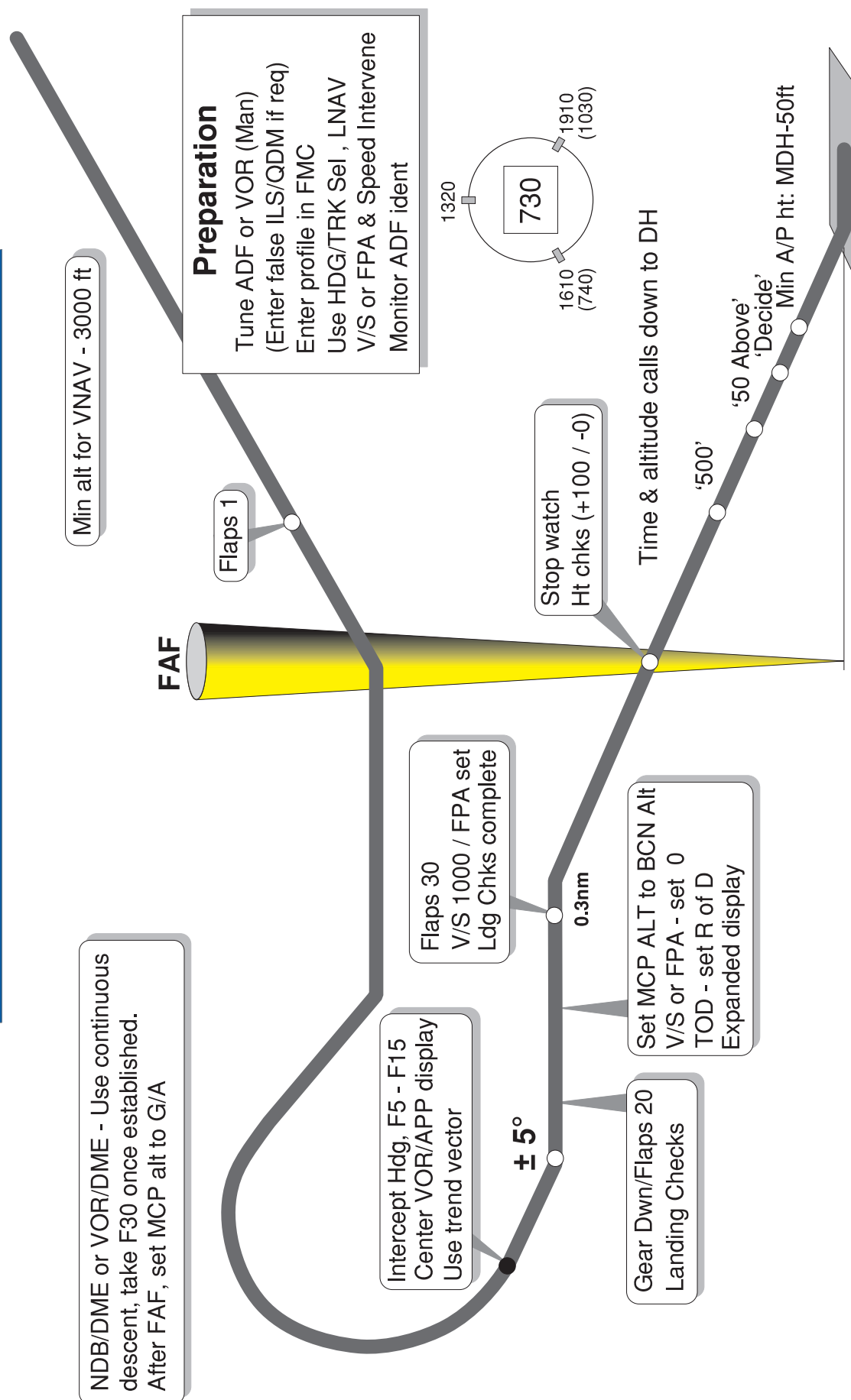
## MAP, FAF & BAP

(Legend book p 2.9.1 Feb 87)

- ❖ The MAP is the point in an approach at or before which the G/A must be initiated to ensure minimum obstacle clearance. G/A if the MAP is reached before visual reference is acquired.
- ❖ If a turn is specified in the G/A procedure, do not turn until passed the MAP & climb established.
- ❖ For a precision approach – MAP defined as the intersection of G/S & DA/DH, & is not shown on plates.
- ❖ Precision approaches do not have a FAF, only a Final Approach Point, which is the intersection of the electronic glidepath with the intermediate approach altitude/height.
- ❖ A maltese cross (FAF) on ILS charts indicates the chart is a combined precision and NPA chart.



# Non ILS (Raw Data) or Non Precision Approach



Note: Whenever ALT HOLD engaged, set the next required alt  
G/A ALT must be higher than current ALT otherwise it captures in further descent.

## Non-ILS (Database) Semi Precision Approach

- ❖ An A/P or F/D must be serviceable
- ❖ Approach in the FMC database, published plate and no special authorisation required
- ❖ Advise ATC of any failure of nav equipment below that required for RNP approach
- ❖ A Dual RNAV approach requires  $2 \times$  FMCs & either a serviceable A/P or F/D
- ❖ Select and check the Procedure.  
Check ND PLAN/FMC Legs against published chart. No modifications allowed. ND lateral path must pass through Fly-Over WPTs.  
Check GPS serviceable.  
Track angles may vary by up to 2 degrees due to discrepancies in the magnetic variation tables held in the FMC.
- \* LNAV may be used to:
  - HOLD or route direct to FMC WPTs, including Fly-Over WPTs
  - Intercept a procedure
- \* Check terrain clearance which may be reduced.
- ❖ Check map accuracy, check min temp & glidepath angle. If a min temp is shown on the RNAV chart do not add 50ft to the MDA. Temperatures below stated minimum means obstacle clearance is not assured.
- ❖ ISA temperature deviation. If the temperature is low, the approach will be shallower than the published slope. If the temperature is high, the approach will be steeper. Consider what you expect the visual picture to be after breaking cloud.
- ❖ Set QNH. Either by ATC prompt or at QNH point on approach plate.
- ❖ Consider actions in event of NAV UNABLE RNP (QRH 11.7)  
RNAV max track error allowed is  $1 \times$  RNP
- ❖ Arm LNAV when cleared to intercept the final approach track.  
Ensure there is an active waypoint on extended centre line ahead of the aircraft.
- ❖ If used, VNAV must be engaged before passing the FAF. When selecting VNAV on final approach always press speed intervene button to open window and reset required speed.
- ❖ Establish landing config prior to FAF if practicable.
- ❖ For VNAV approaches, monitor vertical path using VNAV pointer and scale on ND.  
If in VNAV SPD use power/speedbrake to achieve a CDA and maintain ATC speeds.  
For FPA or V/S approaches, monitor against DME.
- ❖ MCP speed intervene must be selected before the FMC command a speed below FUP manoeuvring speed.
- ❖ Action in the event of VNAV ALT being annunciated on VNAV approach.  
Whenever VNAV ALT is shown in FMA, HP must monitor VNAV pointer. If the aircraft is going high action will need to be taken by the pilot to encourage the aircraft to resume descent.  
Usually winding MCP down to a lower safe altitude and pressing ALT SEL will resume the profile. There is always a pause between pressing ALT SEL and descent: be patient, do not press twice, (or the FMC altitude constraints will be deleted).
- ❖ HP monitors ND MAP on lowest range and VNAV PATH pointer. VOR needles to be displayed on the ND.  
If GPS serviceable - HP & NHP shall use MAP display.
- ❖
- ❖ For VNAV, max deviation below vertical path = 125ft (approx 1/3 scale).
- ❖ On a VNAV approach, and cleared for approach, and VNAV PTH, SPD or ALT annunciated, reset MCP ALT to MDA.  
VNAV PTH must be annunciated before FAF. Check VNAV PTH and LNAV on FMA and MDA above altimeter tape.
- ❖
- ❖ Past FAF and >300ft below Go-around altitude. Reset MCP to go-around altitude.
- ❖ IF VNAV ALT indicated after FAF. Wind MCP down to MDA & press ALT SEL button promptly - once only.
- ❖ Autopilot disconnect by 50ft below MDA. Flight Directors off when established on the visual profile.
- ❖ G/A: VNAV PTH may not be annunciated until a cruise altitude is entered into the FMC.
- ❖ With FPA or V/S annunciated, ensure the FAF altitude will not be infringed before selecting the MDA in the MCP alt window.  
With FLCH annunciated, do not set MDA in the MCP window due to the risk of descending below the profile.
- ❖
- ❖ For successful approach ensure have:
  - \* Active & valid waypoint
  - \* VNAV PTH
  - \* MDA (selected altitude as viewed on the PFD)  
Engage in order (i.e. LNAV, VNAV, MDA), for success.

(AS)

(DS)

See notes in manual for Autothrottle Rate Bias Anomaly

(FCom1 SP-04-12 Jun 10))

## ILS PRM (Precision RWY monitor) procedures

(FCom1 SP-04-12 Mar 06 / FCN 14/4 Aug 04)

- ❖ Used for parallel ILS approaches with RWYs 3000—4300ft apart, down to CAT 1 limits.
- ❖ Airport has to be qualified. (MSP, PHL)
- ❖ Pilot must be qualified.

### ATIS & Briefing

- ❖ ATIS will broadcast 'ILS PRM approaches in progress'.
- ❖ Check have correct letdown plate (PRM - Simultaneous close parallel approaches).
- ❖ Note details on 'Attention all users' page.
- ❖ NPAs not allowed - and two radios required.
- ❖ Do not fly a CDA (continuous descent App), use idle power.
- ❖ A/P strongly recommended.
- ❖ Briefing to include Breakout manoeuvre:—
  - \* Avoid use of TOGA and disconnect A/P & F/D
  - \* A/T will still provide speed control without F/D
  - \* How/when to re-engage A/P & A/T and re-configure A/C
  - \* Heading & Pitch attitudes to achieve clearance

### Dual VHF comms required

- ❖ Each RWY has two frequencies, the primary tower frequency and a monitor frequency.
- ❖ To avoid blocked transmissions during a breakout, ATC will transmit on both frequencies. Transmissions from the "monitor controller" over-rides the "tower controller" on both frequencies.
- ❖ Pilots will ONLY transmit on the primary tower frequency. It is important that pilots do not select the monitor frequency until instructed to contact the tower.
- ❖ The volume levels should be set about the same on both radios.

### Breakouts

- ❖ ATC will issue a breakout if other a/c blunders into the 'No Transgression Zone' (NTZ).
- ❖ Breakout must be hand flown, precisely and expeditiously, (within 8 secs of instruction). It should not require the use of TOGA, nor immediate A/C config changes.
- ❖ The phraseology for the breakout will be: "TRAFFIC ALERT, Speedbird 123, TURN (left/right) IMMEDIATELY, HEADING (degrees), CLIMB/DESCEND AND MAINTAIN (altitude)."
- ❖ In a rare case of a descent instruction, any clearance given will be no lower than the minimum vectoring altitude (MVA) which gives at least 1,000ft required obstruction clearance.
- ❖ HP — disengage A/P & follows ATC instructions, (do not press TOGA). To climb, go for 10° max, for descent just maintain current descent rate as for the ILS. Re-engage A/P when F/D modes set.
- ❖ NHP — replies to ATC, F/Ds OFF, dials HDG SEL and MCP alt, When required HDG & pitch established: F/Ds back ON. (This reduced unnecessary PFD commands). Initially the basic mode of HDG HOLD † V/S or ATT † V/S (bank >5°) will engage.
- ❖ HP confirm appropriate FMA's before engaging A/P. Refine when A/P available. Then need to play catch up with the a/c config. F20, then gear up.  
Note that A/T will maintain SPD control even with F/D off.

### TCAS

- ❖ TCAS is vertically based, and PRM requires a turn.
- ❖ Follow TCAS pitch, and follow ATC turn.

## P-RNAV Approaches

(FCom1 SP-04-7 Mar 06)

### General Briefing

(FCom1 SP-04-9 Mar 07)

- ❖ Both pilots must be qualified.
- ❖ RNAV & GPS equipment must be serviceable. If there are no warnings consider it serviceable. (See MEL for any restrictions).
- ❖ An A/P or F/D must be serviceable, (A/P required for RFAP). A/P must be disengaged by 50 ft below DA.
- ❖ Prior to top of descent, check the ANP. RIAP requires RNP  $\pm$  1nm. RFAP requires RNP  $\pm$  0.3nm. Consider an alternative approach if outside limits.
- ❖ If a procedure does not have a stated RNP, the FMS will default to 0.5. Amend to 0.3 (POS REF page 2).
- ❖ Where a navaid is specifically required it must be available. Navaids that are promulgated as u/s must be deselected.
- ❖ It is recommended that navaids are monitored, where possible, for cross checking purposes.
- ❖ Pilot insertion or alteration of waypoints are not allowed. RNP values for the procedure are coded into the FMC. Altering a waypoint defaults to a lower standard RNP value, which is not suitable for the approach.
- ❖ Note the QNH setting point, and any speed restrictions.
- ❖ Check the STAR, Transition and, if applicable, the RFAP in the FMC against the plate and the ND (use plan mode).  
In particular, check:–
  - \* The waypoint sequence, tracks and distances
  - \* Which waypoints are fly-by or fly-over. Ensure the track on the ND shows this correctly. The ND lateral path must pass through Fly-Over waypoints. (OMN 27/08 Nov 08)
  - \* Speed and altitude constraints are correctly displayed in the FMC
  - \* The final approach angle from the FAF is correct.
- ❖ Brief for the transition from LNAV to HDG SEL to achieve a suitable intercept angle for the approach.
- ❖ Check min A/F temp is within limits set by the approach plates. Where a min temp is published the normal +50 ft NPA increment is not required. If no min temp is specified use the normal perf man minima and add 50 ft to the published MDA (h). Consider the ISA deviation. When the temp is high, you will be high. When the temp is low, you will be low.
- ❖ Advise ATC of any failure of RNAV equipment that is below the limits for the intended procedure.

### RNAV Initial Approach Procedure (RIAP)

- ❖ A/P is recommended.
- ❖ Use LNAV to fly the lateral profile. Set MCP altitude to FAF altitude (or a more limiting ATC clearance)
- ❖ The use of VNAV with speed intervene, is preferred. This maintains direct control of speed, and prevents speed from falling below Flap Manoeuvring speed for the config set. (i.e. do not use VNAV on its own). Use speedbrake as required. FLCH, V/S or FPA can be used provided published alt/speed constraints are met. MCP needs to be updated for each altitude.
- ❖ Set the MCP to the Initial Approach Fix (IAF) altitude once cleared for the procedure.
- ❖ ATC clearance to follow the RIAP implies clearance to descend with the procedure. If in doubt, ask!
- ❖ **Only push the MCP ALT button ONCE to start descent, otherwise vertical restrictions are deleted from the LEGS page. Pushing the MCP button in the descent will also delete altitude constraints.**
- ❖ Closely monitor LEGS magenta targets, both lateral and vertical.
- ❖ Monitor profile carefully.
- ❖ Check the FMA after making any MCP changes.
- ❖ SET QNH at the altimeter setting waypoint. Initiate the Approach Checklist.
- ❖ If flying the RIAP to intercept an ILS, intercept the localiser in LNAV if GPS serviceable or HDG SEL if not.

### RNAV Final Approach Procedure (RFAP)

- ❖ Final Approach Procedure extends from FAF to DA.
- ❖ Both pilots must be qualified for RFAP.
- ❖ A/P must be used, and disengaged no later than 50ft below DA.
- ❖ LNAV must be used for the approach. Use MAP display unless navaids are to be monitored as part of the procedure.
- ❖ VNAV, with speed intervene, must be used. VNAV PTH must be annunciated during approach.
- ❖ Approach gradient is dependent on the OAT. Note the min temp on the Approach plate.
- ❖ GPS must be serviceable. Confirm on ND.
- ❖ At Initial Approach Fix (IAF), A/C should be at platform altitude, QNH set, gear down and flap 15 or 20. At the platform altitude ensure VNAV PTH/ALT engaged, and once the FAF is the active waypoint set the MCP altitude to MDA. Flt a level platform to the FAF (typically 2nms). Commence the final descent at the FAF.
- ❖ Aim to be in the landing configuration by the FAF unless the plate has a more restrictive speed limit.
- ❖ The vertical profile is shown on the VNAV PTH pointer on the ND. HP should select lowest MAP range. NHP should monitor XTK and VTK error on PROGRESS page 2.  
Certified vertical path performance on the Approach is  $\pm$ 125ft (FSD of the VNAV PTH pointer is  $\pm$  400ft). i.e. approx 1/3 scale deflection on the VNAV PTH pointer. Do not descend more than 125ft below the profile.
- ❖ The lateral error is  $1 \times$  RNP. For a RNP 0.3 approach, the max XTK error = 0.3nm.
- ❖ Set the G/A altitude when more than 300ft below the G/A altitude to avoid a nuisance ALT CAP. G/A altitude should be set by 1000ft.
- ❖ If VNAV ALT annunciated, must push MCP ALT button to start descent.
- ❖ LOC Back course — Do not use LOC roll mode. Insert ILS freq/front course QDM. Select GRD PROX G/S INHIBIT.

## Directs

- ❖ 'Direct to' clearances which by-pass the initial legs of an approach, may be accepted, but pilot insertion of waypoints is not allowed.
- ❖ Going direct to a 'Fly Over' WPT will change it to a 'Fly By' WPT. Note this may reduce terrain clearance.
- ❖ Construct an extended C/L from the IAF and once on an intercept heading, select LNAV.
- ❖ Configure A/C to be at the IAF at the correct speed and altitude.
- ❖ Allow LNAV to intercept the final approach track. At the platform altitude, in ALT HOLD, select VNAV then speed intervene, and check FMA for VNAV PTH.
- ❖ 'Direct' clearances to the IAF are acceptable provided the resulting track change onto the final approach does not exceed 45°.
- ❖ 'Direct' clearances to the FAF are acceptable provided the resulting track change onto final approach does not exceed 15°.

## Non - Normals

### NAV UNABLE RNP Caution

The database coding of a RNAV app includes the RNP and if ANP exceeds RNP, get a NAV UNABLE RNP message. Go-around or use alternative procedure.

RIAP - Inform ATC unable RNAV - request radar vectors

RFAP - select HDG mode and either:-

- \* Continue with a visual approach if visual with the runway.
- \* Continue with radar vectors to another approach (SRA / PAR), if pre briefed.
- \* G/A

### Autopilot failures

Continued manually using F/D guidance.

If an A/P mode fails (e.g. LNAV, VNAV) either continue to land if visual, or G/A.

### TCAS, Windshear and EGPWS warnings

These always take precedence and must be followed.

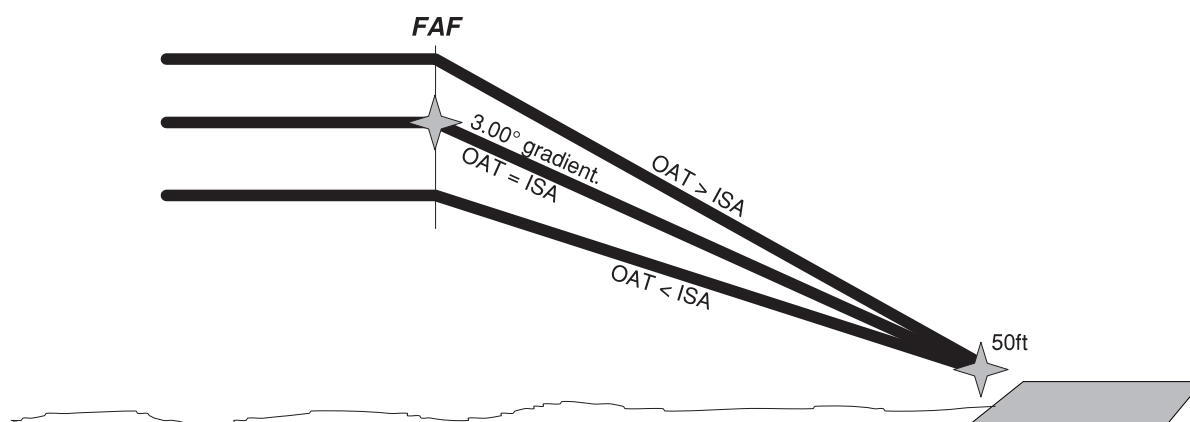
### After a G/A

If radar vectors flown to an RNAV Final App, VNAV ATL may be annunciated. VNAV PTH is required for approach so re-enter a cruise altitude in the FMS perf page.

## Common Problems

(DS)

- ❖ When selecting VNAV, prior to commencing final approach, speed window closes and the target speed reverts to FMS speed. Wait a couple of seconds, then open the speed window and re-select the desired speed.
- ❖ VNAV SPEED appears when speed window is opened & means priority is given to speed. So monitor the path. Selecting flap changes FMA to VNAV PATH & means priority is given to PATH. So monitor speed. Use S/brake as required. Excess speed on approach FMA will revert to VNAV SPEED.
- ❖ DO NOT select the MDA in the MCP unless VNAV XXX (or ALT) is annunciated.
- ❖ Set G/A altitude when at least 300ft out of the go-around altitude (not necessarily the platform altitude). As a reminder to set G/A alt do not clear the landing checklist until it is set.
- ❖ See below for temp variations on approach. Think about the mental picture of the RWY when visual.



**Effect of temperature on approach gradient**

## Landing Phase

### RWY Status

(PerfM. 4.2.1 Feb 97)

Indicates how A/P to be used. Only RWY's with ILS have a status.

- ❖ A RWY – No reference to 'A' RWY found.
- ❖ B RWY – Basic RWY, Autocoupled approach to 100R.
- ❖ E RWY – RWY suitable for A/land evaluation and Cat 2 limits (e.g. KMKE)
- ❖ L RWY – Suitable for Autoland, but not necessarily for Cat 2 or 3A.
- ❖ LR RWY – A/Land with Rollout.
- ❖ No Status – A/P must not be used for the approach.

### Landing Performance Criteria

(PerfM. )

The performance criteria assume:–

- ❖ Flap 30 / Vref30 + 15kts
- ❖ No reverse for normal ldg (dry or wet), but available reverse for Braking Action Med.
- ❖ Full reverse thrust BOTH engines if RWY is slippery,
- ❖ Max wheel brakes
- ❖ Spoilers????
- ❖ Normal ldg performance data assumes a wet RWY.

### Autobreakes

(FCom1 NP-70-12 Jun 09)

- ❖ Requires HYD SYS R to be pressurised.
- ❖ Use:– Manual braking if long RWY and long rollout, (Gulf/DEL)
  - 1 or 2: Routine ops. (Note: A/B 1 increases wear compared with Man braking or A/B 2 or more) (News L Nov 05)
  - 3 or 4: RWY contaminated or slippery, or when limiting RWY length
  - MAX: in emergency or mandatory.
- ❖ Factor 200m to braking chart for a RET.
- ❖ Normally transition from A/Brakes to manual at about 60kts. Use lower transition down to safe taxi speed if slippery.
- ❖ Max Autobrake only gives A/Brake 4 until the pitch < 1° then gives Max Auto. (TM[FC2] 14-20-05 Apr 03)
- ❖ Hot/Hi A/F – high G/S – consider larger A/Brake setting. (FCOA 4, 6 Jun 01)

### Manual Braking

(FCom1 NP-70-13 May 07)

- ❖ Consider manual braking if long RWY and long rollout, (Gulf/DEL). (FCom1 NP-70-13 May 07)
- ❖ Use one long application.
- ❖ Full manual braking gives better deceleration than MAX AUTO, except for slippery case.
- ❖ Short or slippery RWY, use full pedal travel, until at safe taxi speed.

### Arrester cables

(A[1] 8.13.3 Jun 08 / FCOA: 4 Oct 06)

- ❖ Approach cable must be “Rigged & Down”. In this case, no speed restriction crossing cable.
- ❖ Use normal approach, do not attempt to land beyond approach cable.
- ❖ Avoid max reverse thrust and high levels of braking when crossing cable.
- ❖ Inspect ldg gear for damage during ‘walkround’.
- ❖ When taxiing over “Rigged & Up” cable, avoid nosewheel striking rubber doughnuts and not greater than 25kts.
- ❖ No ldg perf. penalty if ldg over the approach cable (“Rigged & Down”) & the overrun cable (“Rigged & Up”) at slow speed.

### Reverse Thrust

(FCom1 NP-70-11 Jun 09)

- ❖ **Reverse Idle** – normally used. SOPs to use at least Reverse Idle on any landing irrespective of RW length. If not used - ASR it.
- ❖ **Full Reverse** - use for limiting conditions, such as:–
  - \* RWY slippery or contaminated with snow slush or ice,
  - \* Target threshold speed has been increased,
  - \* Any unserviceability of speedbrakes/wheel brakes/antiskid, (i.e. Full revs not reqd for SE ldg).
  - \* RWY length limiting.
- ❖ **Handling Full Reverse:–**
  - \* Full reverse can be used down to 60 kias.
  - \* NHP ensure reverse idle by 30kts.
  - \* Idle reverse can be used to a safe taxi speed or a full stop if required.
  - \* For slippery RWY – use MAX reverse until safe stop is assured.
  - \* Beware surges at low speeds. Select reverse idle on both engs, shut down affected eng if reqd.
- ❖ NHP calls 60kts.
- ❖ Directional control problems – call “Reverse Idle”. (Asymmetric reverse thrust NOT recommended).
- ❖ **Do not attempt G/A once reverse is initiated - make a full stop ldg. (In case reverse does not unlock when attempting G/A).**



**Landing Roll Procedure**

(FCom1 NP-70-11 May 07)

- ❖ Steel yourself. **Don't flare till T/Lever close at 25ft.** Do not float!!!!
- ❖ For wet/icy RWY do not need to remove crab angle, (reduces drift on RWY).
- ❖ On RWY's < 200ft wide – Land with flt deck offset up wind. (Keep to the professional side).
- ❖ Get "BANK ANGLE" call if >10° roll at 50R.
- ❖ Normal T/down attitude is 4–5°. Gives aft body clearance of approx. 55 ins, (4 ½ft, 1.4m).
- ❖ NHP to call "ATTITUDE" if pitch attitude > 7.5°, (3 divisions on PFD).
  - \* Tail scrape occurs @ 10°, wings level. ASR!
  - \* Wing tip/LE Slats scrapes can occur @ > 10° roll.
- ❖ Full Reverse - use for limiting conditions,
  - \* Full reverse can be used 60kts.
  - \* NHP ensure reverse idle by 30kts.
  - \* For slippery RWY: Full reverse until safe stop is assured.
- ❖ NHP calls 60kts.
- ❖ Do not use nose wheel steering till safe taxi speed.
- ❖ Hi speed turnoff when < 50kts & reverse idle achieved.
- ❖ Directional control by asymmetric reverse thrust NOT recommended, call "Reverse Idle".

**RET MAX exit speeds**

(A[1] 8.3.20 Jun 08 / BALPA LOG Apr/May 02)

- ❖ 30° RET = 35kts, 20° RET = 50kts. (LGW 26L 'FR' = 52kts, 08R 'CR' = 49kts)
- ❖ When RET available, add 200m to the 'A/Brake setting for ldg' guide.  
A TCAS target of +07 = 1 min separation.

**G/A (See also AWOPS section 7.15)**

(FCom1 NP-70-15 Jun 09 / TM[FC2] 04-20-17 Apr 03)

- ❖ PRESS THE TOGA BTN. Ensure FMA = THR / TOGA / TOGA
- ❖ Use Flap 20 unless specified by QRH.
- ❖ If manual, rotate to 15° NU, (make a positive rotation, as there is no power coupling). Follow F/D.
- ❖ Limit bank to 15° if airspeed less than Min Man Speed.
- ❖ 2nd push on TOGA for max thrust if required.
- ❖ Above 200 agl – A/P in: Above 400R – select LNAV. (Must have active, magenta, waypoint ahead for LNAV).
- ❖ Spd commanded is between the command speed and command speed + 25kts.
- ❖ At Aa – Spd intervene to Vref30+80.
- ❖ Note: TOGA rudder control is lost when another pitch/roll mode selected or MAP altitude captured. TAC continues to work.
- ❖ After flap retraction, select VNAV or FLCH. Thrust limit reverts to CLB thrust.
- ❖ Below 1000 aal normal G/A. (A[1] 8.3.19.1 Jun 08)  
Above 1000 – G/A procedure at Capt.'s discretion. Full energy G/A not required.  
Care with flap - may be a F20 already. What call are you going to make?
- ❖ Above 1500ft, the A/P may be used for the G/A by deselecting the A/P mode, and selecting V/S and lateral mode.
- ❖ Below 1500ft the A/P mode can only be disengaged by disconnecting the A/P & both F/Ds, or engage the G/A mode.
- ❖ **On a performance limiting RWY, G/A if speed over threshold > Vref30 + 15.** (FCom1 NP-70-9 May 07)
- ❖ After 2 G/A's in marginal WXR, consider diverting, or hold for improvement in WXR. A 3rd attempt only after significant improvement in WXR. (A[1] 8.3.19.1 Jun 08)
- ❖ In the US, brief for possible Vis approach G/A, i.e. St ahead & shout for help.
- ❖ If MAP includes a reverse turn, ensure can see it on ND – use the CNTR btn. (J Potter)
- ❖ File ASR for a G/A.
- ❖ Beware: if making a G/A from a high energy approach with the speed brakes out, ensure that the speedbrakes (and gear) are retracted at the appropriate points. It is just too easy to be distracted by ATC etc. You will be filing an ASR anyway:–)
- ❖ **Caution: If VNAV selected (above 400ft AAL) and the active waypoint has an altitude constraint below the a/c, VNAV ALT is annunciated, and a/c descends. Use FLCH and set speed to get out of the hole.**

**Inadvertent use of TOGA**

(TD)

- ❖ TOGA is terminated by selection of any other pitch & roll mode.

**Handling Pilot**

- Switch off F/D – disengage A/P – fly manually
- Remain on profile

**Non Handling Pilot**

- Switch off F/D – disengage A/P – fly manually
- Switch BOTH F/Ds back ON
- Rearm Approach mode - Ensure LOC G/S or select modes to recapture.
- Re engage A/T.

**Handling Pilot**

- Re-engage A/P

## Baulked Landing and G/A

- ❖ A G/A may be initiated at any time up until the point that reverse thrust is selected (even after speedbrakes deployed).
- ❖ Do not G/A after reverse is selected. (In case one reverse fails to unlock).
- ❖ A tricky manoeuvre...and one which should never be needed - a sim exercise only. (G Leask)
- ❖ HP calls "G/A" – sets full power – spoilers auto retract and auto brakes disengage. (TOGA doesn't work on the ground).
  - \* NHP calls "ROTATE" @ Vref30
  - \* When airborne: HP calls "G/A Flaps 20"; & press TOGA – this puts checklist into correct place.
  - \* NHP calls "Positive climb"
  - \* HP calls "Gear Up"

## Braking Cooling

(FCom1 NP-60-13 Mar 03)

- ❖ Takes 15 mins for brake temps to stabilise.
- ❖ If last Ground time + Flt time < 90 mins, extend gear early by 5 mins.

## EAI msg after Ldg (GE engs only)

(FCom1 SP-16-7 Mar 03)

- ❖ Increase N1 by 3% for 1 min. Cycle EAI switch.

## Taxi in & Parking

(FCom1 NP-70-1 Mar 07 / A[1] 8.2.0.1 Jan 10)

- ❖ Although approved in the FM, consider very carefully before routinely shutting an eng down during taxi!
- ❖ Prior to shut down, cool an eng for 1 min (or 3 mins if full reverse has been used).
- ❖ NHP to monitor G/S.
- ❖ One crew member to keep headset on till engs rundown.
- ❖ Do not taxi onto stand unless the SEG is illuminated or mashaller gives clearance.
- ❖ Check stand is clear of obstructions, the guidance system is operative, and the SEG indicates correct a/c type.
- ❖ If SEG fails: STOP, inform ATC, await mashaller. Note: a reinstated SEG may still give false guidance, await mashaller.
- ❖ If STOP SHORT sign displayed – taxi short of air bridge & adjacent to sign. Inform ATC if tail infringes taxi way. (A[1] 8.2.0.1 Jun 08)

## Tow On Procedure

(FCom1 SP-10-9 Mar 03)

- ❖ See manual for official procedure.
- ❖ Approaching stand "Doors to manual".
- ❖ With total failure of electrics (Tug or A/C) stop towing & restore electrics / brake pressure. However it is OK to continue if a towbarless tractor is used.

## Min Fuel for Ldg

(A[1] 8.3.7.4 Jun 08 / Tech Log Instruction Man Jan 03)

- ❖ Engineers will raise a MOR if fuel is less than 2840 kg. Based on Reserve fuel of 30 mins holding @ 1500ft at Max Ldg Wt.
- ❖ If landed with less than CIRRUS reserve – Raise ASR. (A[1] 8.3.7.4 Jun 08)

## Heavy Ldg

(A[1] 8.3.2.3 Jun 08 / 3 Fleets Mag)

- ❖ Ldg 'G' see side screen → Condition Monitoring → BA reports → Tail Clearance → Ldg.
- ❖ No auto ACMS printout if heavy ldg. SESMA: >1.4g is recorded, 1.8g – alert, 2.0g – get phone call,
- ❖ 2.16/2.36g (depends on mod state) is official Heavy Ldg.
- ❖ If, in Capt's judgement, ldg is hard – raise ASR & report in Tech Log as "Hard landing inspection required".

## Status messages

(FCom1 NP-70-3 Mar 06)

- ❖ Wait 3 mins after HYD PRESS SYS L+C+R message appears before recording status and alert messages in the tech log.

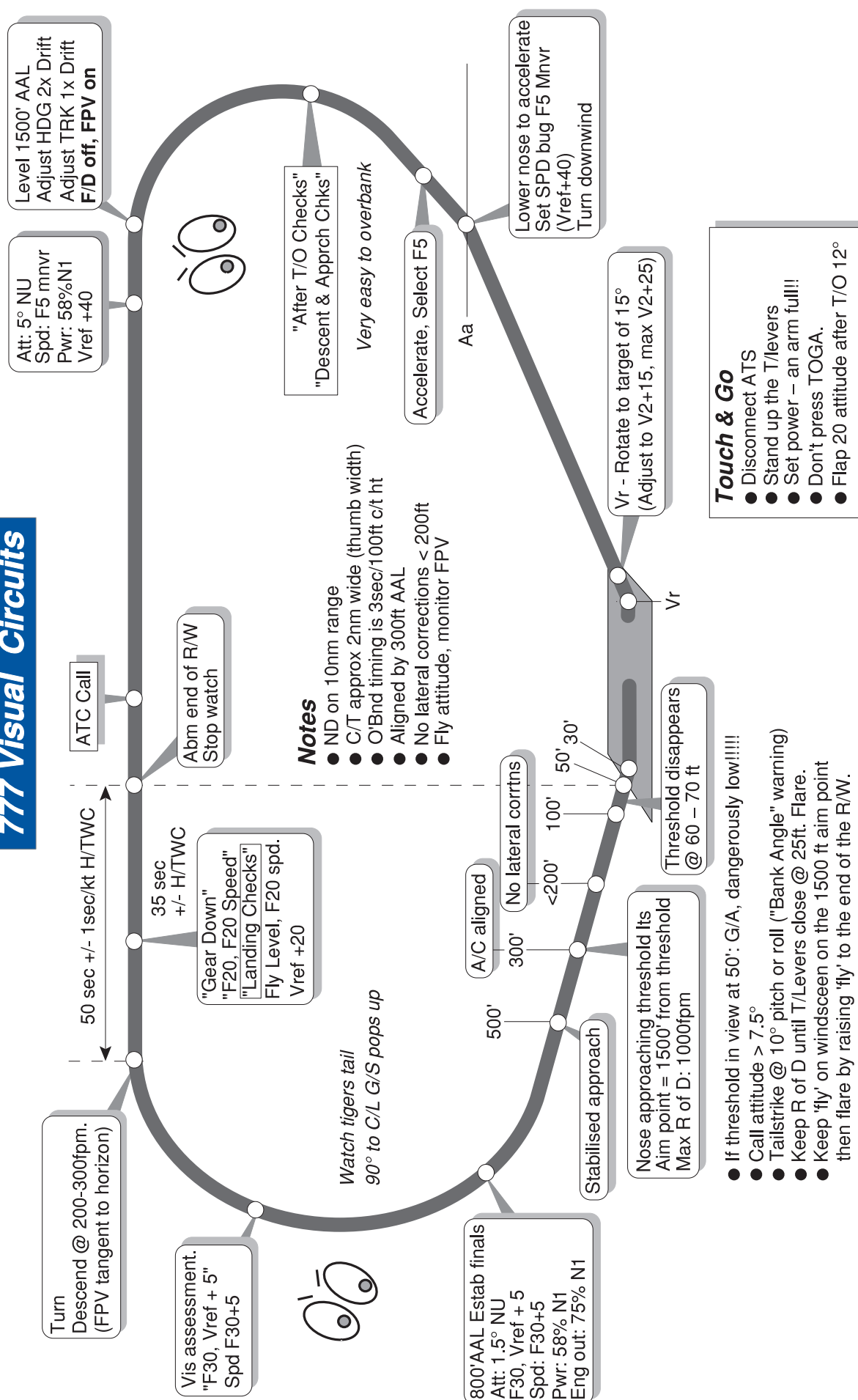
## –300/–200 diffs

(Aug 11)

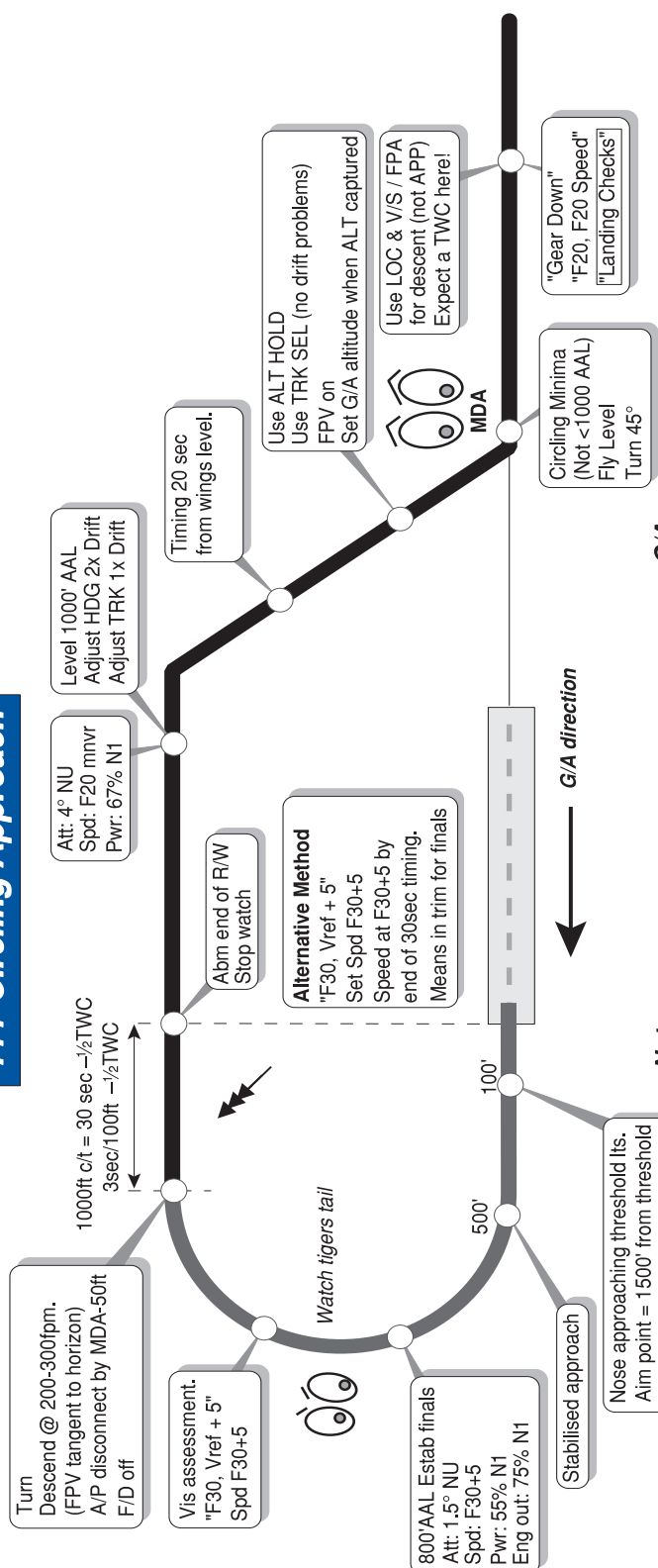
- ❖ Vref:
  - \* At MLW, –300 is 15kts faster
  - \* Heavy –300 vs. Light –200, → 20+kts difference
  - \* Faster approaches ≈160kts.
  - \* Stopping distances: –300 approx 12% longer than –200. Check that the LDA is not limiting, especially in hot climates.



# 777 Visual Circuits



# 777 Circling Approach



## Notes

- ND on 10nm range & remain within 5.3nm
- Put 2nm/5nm rings in fix page
- Consider w/v in deciding turn dirn or... consider which HP is to do the ldg.
- Use LOC & V/S or FPA for G/S, not APP mode
- Early gear gives more GPWS latitude
- Set DH then set ALT mode to AUTO. Can then set DH in MCP.
- C/T approx 2nm wide (thumb width)
- O/Bnd timing is 3sec/100ft c/t ht or 15sec/500ft c/t ht
- Must remain vis with R/W during C/T, therefore set G/A alt asap after ALT Cap of MDA
- P1 (HP) can take over at MDA or end of D/wind leg
- Circling Min provides at least 400ft clearance from obstacles within stated radius
- Do not descend below MDA until intercepting the visual profile.
- Limit bank to 25° when F/D's off
- Pink string should change to indicate path to G/A Wpt
- Min reported met vis = 3.6Km, (unless AOM)
- Now possible to transit from circling to visual approach if full visual achieved by 1500ft AAL

## Short Finals

- Aligned by 300ft AAL
  - No lateral corrections < 200ft
  - Fly attitude, monitor FPV
  - G/A if threshold still in view @ 50ft
  - Call attitude > 7.5°
  - Tailstrike @ 10° pitch or roll ("Bank Angle" warning)
  - Keep R of D until T/Levers close @ 25ft flare
  - Both F/D's off - except NHP can monitor F/D if LOC & G/S engaged.
- If F/D's are off - expected to use FPV

Ref: FM/FCI/1 SP-04-13 May 08  
QRH MAN-23-2 May 07  
(A/I) 8.1.3.2.13.x-Jan 10)  
Mike Thrower

## G/A

- Use MAP for initial ILS/NPA approach
- "G/A Flap 20"
- "Positive Clb"; "Gear Up"
- ### F/D ON ###
- Initial turn towards Ldg R/W (even if >180°)
- Maintain G/A flap until close in turn complete
- 200ft A/P in
- 400ft LNAV engage
- Let LNAV sort out the direction to turn
- CLB SSA
- Ensure G/A is the active waypoint (i.e. top of legs pg or top RH corner of ND) before LNAV engaged.
- If G/A with F/D OFF, F/D's disappear with 1st pitch/roll mode selected.
- A G/A downwind, without setting G/A Alt will just allow A/C to accelerate.

## S/Eng App

In thrust limited conditions (Hot/High A/Fs: High Wts) consider retracting gear for circling after MDA. Use GPWS o/rde to prevent nuisance warnings

## Diversion

Only approved alternates may be used for flight planning or in-flight diversion, except in emergency. (A[1] 8.1.2.3 Jun 08)

Only RWYs listed in the AOM manual may be used, except in emergency. (A[1] 8.1.2.4 Jun 08)

If medical diversion: get MEDLINK to organise ambulance, otherwise ask ATC. Any Medical emergency requires a PAN call. (A[1] 6.15.6 Jun 08)

### Conditions requiring landing at nearest suitable airport (NSA)

- \* Eng Fail. Only in exceptional circumstances should the Capt NOT land at the NSA. (A[1] 8.11.13 Jun 08)
- \* Cabin smoke/fire (persistent)
- \* When checklist demands.
- \* In circumstances where onward flight unsafe

### Things to consider:

- \* Weather (Wind TRUE except ATIS and ATC twr)
- \* Runways available — direction, length & crosswind
- \* PCN number- (overridden by AOM notes?)
- \* Fuel dumping
- \* Autoland capability
- \* MSA en-route
- \* MSA at diversion A/F
- \* Approach aids
- \* Fire cover
- \* Medical facilities (Medlink)
- \* Commercial factors
- \* ASK ATC – Local knowledge (but check it).

### Inbound routing

- \* Get WXR from local ATC but also listen to ATIS for local info, e.g. RWY closures!!
- \* Plan before execution. SCCM to Flt deck. NITS.
- \* Arrange steps to appropriate doors.
- \* Inform LHR of diversion via ACARS, include operational state of A/C

### Taxi & Parking

- \* Ask ATC about taxiing off RWY because the taxiways may not be suitable for 777.
- \* Shut down checks & sign T/Log!
- \* See sheets in back of T/Log for “Alleviated ETOPS pre departure check”, (maintrol authorisation).
- \* Note GE engs to have oil levels recorded within 30mins of shutdown.
- \* ETOPS - can't fill oils yourself - need ETOPS qualified engineer. Need a single event authority, (SEA).

### Organise

- \* Contact ops for guidance and with a/c serviceability asap.
- \* PA and then every 30 mins. Brief 1st Class personally.
- \* Grnd Pwr available?
- \* If PAX(s) off loaded then their bags MUST be off loaded too. Pax bags ~ find location via ACARS.
- \* Inform Customs/Immigration if PAX/Crew or cargo off loaded. (A[1] 8.12.1.3 Jun 08)
- \* Capt responsible for any Royal Mail & Dip mail.
- \* CIRRUS - can print own from FMC after route loaded. (Need some thought as format is different).
- \* Refuel. CHECK ZFW & MLW. This may be restricted if you are in an 'A' market A/C.
- \* In this case the max fuel will be of the order of 25 tons for a quick fuel & go.
- \* If off to a hotel, 40 tons fuel min.
- \* Consider releasing cabin crew to assist ground staff if requested/required. (A[1] 8.12.1.2 Jun 08)
- \* Have you got T/O performance figures for this A/F? May have to use a similar A/F to get suitable perf figures although this is less of a problem with CARD.
- \* Loadsheel – use the Nil/Minor change of load procedure, its usually quicker than requesting a new loadsheel.
- \* No change required with up to 5 Pax off loaded. Do need the LIZFW from original ACARS loadsheel.
- \* Sign Loadsheel!!!!
- \* Flt time limitations ~ 3 hrs max discretion unless dire emergency. Problem if any crew on a Back 2 Back and are NOT ACCLIMATISED.
- \* Consult FCN 01/05 for Refuel procedures.

### Departure

- \* Pre flt checks.
- \* Sign T/Log!
- \* Gear cooling?



# 7 • AWOPS & AOM

## Met. Briefing (Airfield Planning)

(A[1] 8.1.2.7 to 8.1.3.1)

### Departure A/F

(A[1] 8.3.0.2.1 Jun 08)

- ❖ Cloud CLG & RVR or Met Vis  $\geq$  T/O AOM – Condition of RWY OK for T/O.
- ❖ For Low Vis T/O (RVR < 400m): Aids OK, LVP's in force, & crew qualified.
- ❖ Normal operating min apply to departure A/F, but consider Single Eng limitations, i.e. a slippery RWY requires two reversers.
- ❖ If RWY braking action is degraded, consult QRH for SE performance.

### Take Off Altn A/F

(A[1] 8.1.2.8 Jan 11)

- ❖ Choose a T/O Altn if you cannot return to departure A/F due met or performance reasons. Must be annotated on flt plan. For 777, return to departure A/F with SE A/Land OK, except if RWY slippery.
- ❖ For ETOPS (Crew & A/C approved): T/O Altn within 120 mins at one eng cruise speed (800nm), (except USA/Saudi – 60 min).
- ❖ For non ETOPS: T/O Altn within 60 mins at one engine cruise speed, (400nm).
- ❖ If nominated: T/O Altn TAF at Altn ETA  $\pm$  1 hr must be at or above:–
  - \* Normal operating min. (Only RVR's taken into account).
  - \* Consider eng failure limitations, (i.e. not slippery RWY).
  - \* If the only approaches available are NPA / circling then CLG  $\geq$  MDH.**Additionally for USA, Canada, Saudi:**
  - \* Ceiling/vis at T/O Altn (if req) must be  $\geq$  state Altn min, (and within 60 mins / 400nm).  
Basic Altn Min (USA/Canada): 600ft/2sm (ILS), 800ft/2sm (NPA). For 2 separate RWYs, can use 200ft/0.5sm above the lower of the normal landing minima.  
Canada complex. See A[1] manual for Canada, Australia and Saudi.

(A[1] 8.1.3.1.4 Jan 11)

### Destination A/F, except Isolated Destination A/F

(A[1] 8.1.3.1.2 Jun 08)

Destination TAF at ETA  $\pm$  1 hr must be at or above:–

- \* Normal RVR,
- \* For a NPA or circling approach, CLG  $\geq$  AOM.

### Destination Altn, En Route Altn & Isolated Destination A/F

(A[1] 8.1.2.9 Jun 08)

Altn TAF at ETA  $\pm$  1 hr must be at or above following stepped down limits:–

- | Lowest Min Available        | Planning Minima                                     |
|-----------------------------|---|
| ❖ Cat 2 or 3 ILS available: | Cat 1 RVR (or factored Met Vis). CLG not a factor.  |
| ❖ Cat 1 ILS:                | NPA RVR (or factored Met Vis), & CLG. (BKN or OVC). |
| ❖ NPA:                      | NPA RVR (or factored Met Vis) + 1000m, CLG + 200ft. |
| ❖ Circling approach:        | Circling minima.                                    |
- 
- ❖ **State** Destination Altn min apply for USA, Canada, Japan, Saudi, (Basic min ILS 600ft/2sm, NPA 800ft/2sm).
  - ❖ Destination Altn not required if:–
    - \* Flt time < 6hrs AND Destination has 2 usable RWYs, and for ETA  $\pm$  1hr CLG  $\geq$  2000ft or circ min+500 AND vis  $\geq$  5km). (Only invoked as last resort)  
OR
    - \* Isolated destination with no adequate Altn.
  - ❖ If destination TAF at ETA  $\pm$  1 hr will be **below** planning minima or TAF not available, then two destination alternates must be selected.
  - ❖ Non ETOPS En Route Altn must be adequate and within 60 mins, (still air SE speed).

**ETOPS En Route Altn.**

(A[1] 8-5-1 Jan 11)

**ETOPS:** = flight > 1 hour away at threshold speed (still air SE speed of 400kts) from an adequate A/F.

For use, an ETOPS En Route Altn must be both Adequate & Suitable.

**Adequate** = available & equipped, (lighting, comms, WXR reports, nav aids, safety cover) **AND** at least one **instrument approach**.

**Suitable** = WXR reports and/or TAF between the ETA until 1 hr after latest possible landing time are above planning minima.

Time window should be within ATC hours of watch (normal or extended), except for Kangerlussuaq (Sondstrom BGSF) and other designated emergency A/Fs, which can be used out of hours for planning.

**Wind:** Mean winds and gusts should be within X-wind limits. TAF's & METAR's are °T. X-wind limits unaffected by engine status.

Jar Ops table for ETOPS planning minima		
App facility	Altn A/F Ceiling	Visibility/RVR minima
<b>NPA or Circling Approach</b>	Ceiling = DH/DA + 400ft	Authorised Min + 1500m
<b>Precision Approach</b>	Ceiling = DH/DA + 200ft	Authorised Min + 800m

Once dispatched, use normal AOM for WXR suitability.

(A[1] 8-5-2 Jan 11)

Capt to consider rerouting if altn WXR deteriorates below limits.

Generally, the ETOPS criteria are more restrictive than the En Route Altn minima.

Note: ETOPS critical fuel based on:

- ❖ Total pressurisation failure, followed by 2 eng diversion at 15000ft
- ❖ Eng failure & simultaneous total pressurisation failure, followed by SE diversion at 15000ft
- ❖ Eng failure followed by drift down & SE diversion.

**General Planning Criteria**

(FCom1 SP-60-02 Mar 08 / A[1] 8.1.3.0.2 Jan 11)

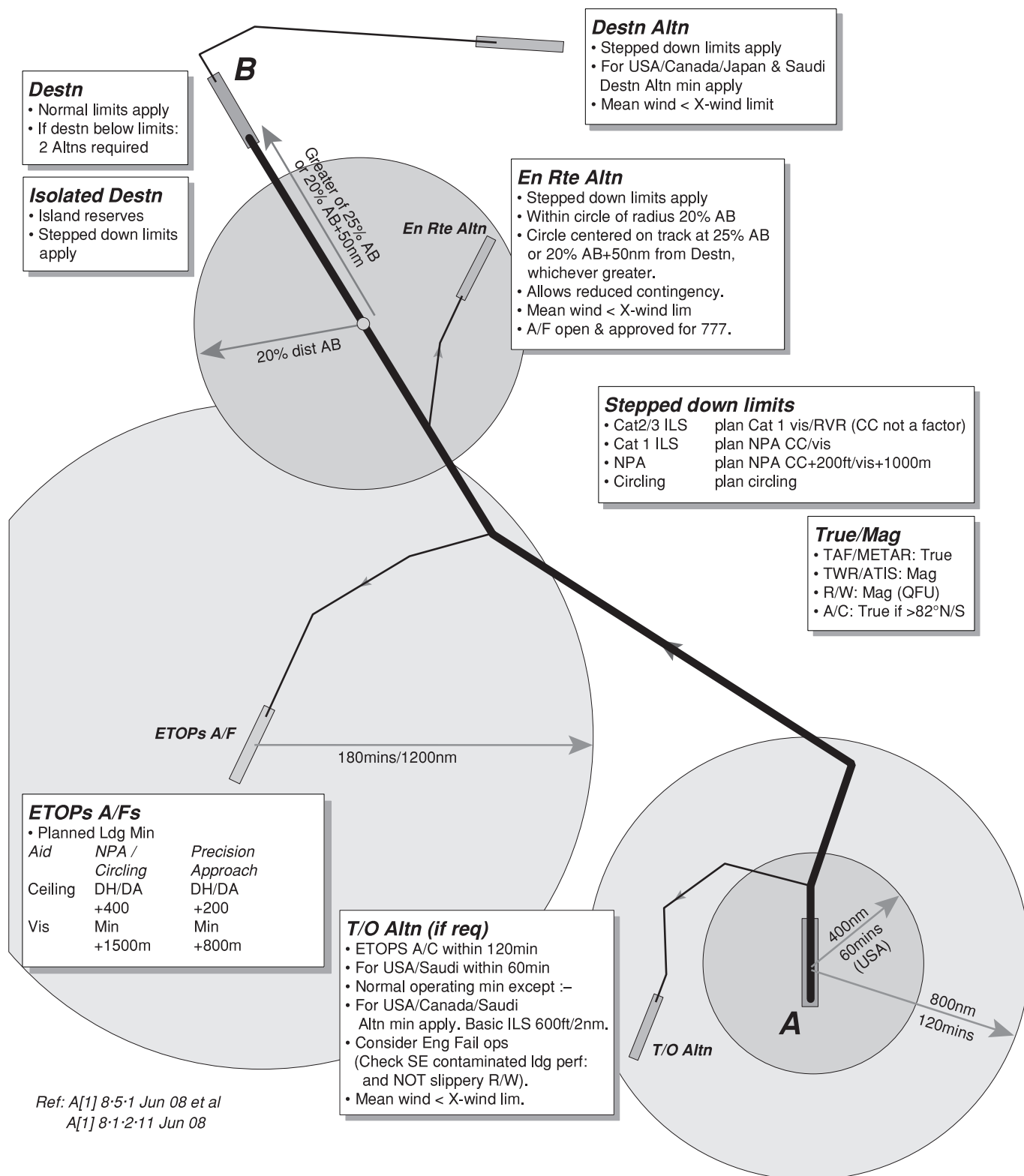
- ❖ BA only takes account of probabilities of **PROB 40** when selecting **Altns**.  
(Capt.'s discretion when looking at Destination WXR with less than PROB 40) (BALPA tech news Mar 03)
- ❖ PROB 30% and PROB 40% TEMPO are disregarded (A[1] 8.1.3.0.2 Jan 11)
- ❖ PROB 30% and PROB 40% forecasts are NOT considered for the T/O Altn or the destination.
- ❖ Cirrus cannot deal with **PROB 40 TEMPO**: & may be disregarded when selecting **Altns**.
- ❖ If no time band associated with **TEMPO** or **BCMG** then can be ignored for planning purposes.
- ❖ TEMPO are temporary changes < 1hr and in aggregate < ½ the period indicated.
- ❖ For **BCMG**: deteriorating conditions apply from start of period, improving conditions from end.
- ❖ Mean wind used for assessment, **gusts ignored**, except for ETOPS En Route Altns. (A[1] 8.1.3.0.2 Jan 11)
- ❖ Cloud CLG = the HAA to the lowest cloud obscuring more than 50% of the sky. (i.e. ignore FEW & SCT)
- ❖ Above criteria required at planning stage. Once airborne, use any A/F above OPERATIONAL limits.
- ❖ NuBrief valid for STD+1hr.
- ❖ TAF's & METAR's are °T. ATIS & Twr are °M.
- ❖ USA – Prob's only used for TS and associated WXR. (BALPA tech news Mar 03)

**En Route Altn Planning & Selection**

(A[1] 8.1.2.9 Jun 08)

- ❖ Allows for reduced CONT & used if destination fuel falls below limits & is additional to normal destination Altn.
- ❖ A/F must be approved for a/c type and promulgated as open.
- ❖ Stepped down or state planning min.
- ❖ Circle radius:– 20% of flt plan dist in flt (DIF), centred on track, at a dist from destination the greater of: –  
25% DIF or  
20% DIF + 50 nm.

## 777 Route Planning





## All Weather T/O

### AWOPS Briefing / AIS

(FCom1 SP-30-1 Mar 03)

- ❖ PVD T/O requires Cat 3 ILS (except UK if a downgraded ILS is promulgated 'suitable for T/O guidance'). Not avail in USA.
- ❖ Check A/Land status (DISC ADD's / OPDEF) and NOTAMS for CAT 2 or 3 at destination.
- ❖ If PVD u/s: RVR for T/O typically 150m.

### At the Aircraft

(FCom1 SP-30-1 Mar 03)

- ❖ Check Tech Log ADD's for Autoland Status (No Land 3/ No Autoland msg). (N.B. A/Land status is limited to ADD declared status in T/LOG till cleared).
- ❖ Check MEL. Ensure no other defect would affect approach capability.
- ❖ Check plates for low vis procedures / holding points / lighting patterns etc.
- ❖ Check Performance Man or **CARD** for T/O limits, CC/RVR/Vis. (PVD 75m @ LHR).
- ❖ Know vis references.
- ❖ In Europe, if flow restrictions in force due destination WX, inform ATC of intended use of CAT 2/3.

### Taxi

(FCom1 SP-30-2 Mar 03)

- ❖ Eng A/Ice ON (if temp < 10°C).
- ❖ Taxi VERY carefully, especially if RVR < 100m.
- ❖ Expect non lit objects to appear visible @ 75m in quoted vis of 100m.
- ❖ If taxiways slippery then do run up on RWY.
- ❖ Consider illuminating ALL A/C lighting [including Strobes & Wing] - {several fatal accidents during taxiing in low vis., the US N.T.S.B. recommends this to FAA for all ops below CAT 1}.
- ❖ Taxiing - beware nosewheel steering LAG caused by low temps - so warm it up by exercising during taxi. Max of 5kts suggested. If traction lost - centralise steering and slow down.
- ❖ During taxi, in or out, in icing conditions and when OAT ≥ 3°C: **Momentary run up to min of 50% N1:-**
  - \* RR Engs - run up at intervals not greater than 60 mins
  - \* GE Engs - run up at intervals not greater than 15 mins
- ❖ On T/O: do static run to 50% and stable eng operation before T/O roll.
- ❖ If taxiways are snow/slush covered, delay flap selection until approaching RWY. This means cannot finish the 'After Starts' until flaps selected. In any event, cannot do control check until flaps selected.
- ❖ Do not overshoot CAT 2/3 holding point (Green taxi lights may extend beyond Cat2/3 hold).
- ❖ Prior to entering RWY, check RWY state and braking action, especially if RVR = 75m.
- ❖ Check RVR before entering RWY.
- ❖ X-Wind limit (DRY) = 40kts; (WET) = 25kts; PVD = 15kts; Contaminated = 15kts.

(FCN 02/05 Jan 2005)

### RR Engine - Taxi in Freezing Fog (Core Ice Removal)

(FCom1 SP-16-6 Mar 06)

- ❖ This procedure does not apply to other ops in freezing ppn, since larger ice particles do not cause core icing.
- ❖ If T/O anticipated within 45 mins of eng start, core ice removal not required.
- ❖ During taxi, in or out, when **Freezing Fog** is reported: **Momentary run up engines as follows:-**
  - \* When OAT between 0° & -6°C, use 50% N1 for 60 secs every 45mins
  - \* When OAT between -7° & -13°C, use 59% N1 for 60 secs every 45mins, (N.B.. T/O Config warning at 60%)
  - \* When OAT < -13°C, manual de-icing required.
- ❖ Taxi in time from previous sector, if it was in freezing fog, to be considered, unless the crew accomplished the Core Procedure within 5 mins of shutdown, or the engine was de-iced and visually inspected by engineering.
- ❖ T/O permitted within 60 min total taxi time without core ice removal. Must be noted in Tech Log. (Boroscope within 10 flts).
- ❖ On T/O: do static run to 50% and stable eng operation before T/O roll.
- ❖ A stopped engine stops the 'clock'. Core ice accumulation only occurs when engs running.
- ❖ Cautions: Jet blast to 900ft (300m); ingestion of snow/ice into eng; slippery taxiways; noise.

### T/O RVR Minima

(A[1] 8-1-3-2-3 Jun 08) / Perf M. 3-3-6 Dec 99)

- ❖ RVR of 75m requires:-  
PVD +15m RWY C/L lighting + RWY edge lights (<60m spacing) + Multiple RVRs + LVPs in force.
- ❖ RVR of 150m requires:-  
15m RWY C/L lighting + RWY edge lights (<60m spacing) + Multiple RVR's + LVPs in force.
- ❖ RVR of 200m requires:-  
RWY C/L lighting + RWY edge lights + Multiple RVRs
- ❖ Notes: ensure appropriate LVPs in force for Low Vis T/O's (RVR <400m).
- ❖ Any State Min overrides the above values.

(A[1] 8-1-3-2-2 Jun 08)



**T/O ban**

(A[1] 8.1.3.2.2 Jun 08)

T/O is banned if any of the following below limits:

- \* RVR assessed from flt deck by Capt immediately before T/O.
- \* TDZ RVR or specified Met Vis. (Factoring not allowed for T/O).  
N.B.: Capt's assessment will override reported RVR / Met vis, except if not practical, i.e. humpy RWY or high RVR limit.
- \* Mid-point RVR, when reported.
- \* Stop end, if specified by AOM notes (USA), otherwise advisory only.
- \* Cloud Ceiling, if specified. (e.g. BOS RWY 22R: CLG 300ft).  
OR
- \* RWY is indistinguishable from its surroundings.

Additionally, do not T/O if:

- \* At night with no RWY lights. (Min of RWY edge & end lights required). (A[1] 8.1.3.2.3 Jun 08)
- \* Condition of RWY. (A[1] 8.3.0.2.1 Jun 08)

If any lights u/s or markings obscured, see A[1] 8.1.3.2.3 [General] & 8.1.3.2.2 [State specific].

**TDZ RVR not available for T/O.** Vis assessed by Capt and may takeoff if criteria for a ban above are exceeded [A[1] 8.1.3.2.3]

Factored met vis not to be used for T/O. (A[1] 8.1.3.2.2 Jun 08)

For USA/Canada refer to A[1] 8.1.3.2.2 et al.

**T/O Unserviceable facilities**

(A[1] 8.1.3.2.2 Jun 08)

- ❖ If RWY lighting is partially u/s or RWY markings obscured, refer to the table in A[1] 8.1.3.2.3, as modified by the State and shown on CARD. Under certain circumstances, the Capt can elect to takeoff if the RWY is distinguishable from its surroundings. Stop end RVR may be substituted for Mid-point RVR.

**Co-Pilots' T/O Limits**

(A[1] 5.2.2.1.1 Jun 08)

- ❖ 600m (2000ft) in all 3 segments.

**Low Visibility Take Off (RVR <400m)**

(A[1] 8.3.0.2.2 Jun 08 / FCom1 SP-30-3 Mar 03)

- ❖ Ensure appropriate LVP's in force, visual & non visual aids OK, crew qualified.
- ❖ Use TCAS to monitor preceding traffic – ensure they have in fact got airborne!! (A[1] 8.3.0.2.1 Jun 08)
- ❖ Line up on RWY C/L lights, not edge lights!  
Edge lights are 30m spacing, check can see them for orientation. (M Freeman)
- ❖ Check HSI against RWY hdg.
- ❖ Check visibility consistent with required AOM, (legal requirement). (A[1] 2316 Jun 05)  
(No. of visible lights: RVR = 75m, 4 lights @ 15m spacing: RVR = 150m, 9 lights @ 15m spacing).
- ❖ Note that a displaced threshold will be lit by approach C/L lights @ 30m spacing.
- ❖ Switch on RWY Turnoff lights, (RTO & fire service location).
- ❖ As you rotate, you lose all visibility outside. Concentrate on correct rotation & attitude.

**PVD T/O**

(FCom1 SP-30-2 Mar 03)

- ❖ Only 1 PVD means stop end RVR must be at or above AOM.
- ❖ X-Wind limit = 15kts.
- ❖ Check ILS is CAT 3 (and not downgraded) or is 'Suitable for T/O guidance'.
- ❖ Enter ILS Frequency/QDM on to NAV/RAD Page, (Delete freq after T/O!!).
- ❖ Ident ILS, (visually on PFD).
- ❖ Switch on PVD's before holding point, suggest at the briefing stage. With the VITAL DATA check, make sure they are ON.
- ❖ Check EICAS for PVD messages:– **PVD CAPT ON**, **PVD FO ON**, **PVD BOTH ON**
- ❖ PVD unshutters when hdg within 45° of ILS front course. (TM[FC2] 10-20-10 Apr 03)
- ❖ Vis should be 4 C/L lights (75m at 15m spacing). Capt.'s assessment takes priority over RVR.  
(PVD T/O's require 15m C/L lighting).
- ❖ Check ILS LOC. (1/3 dot if lined up on edge lights).
- ❖ Note: PVD takes data from LOC and ADIRU so the PVD streaming affect is rate sensitive. If approaching the C/L at correct rate it will not appear to move. PVD shows direction to steer. (G Hallatt)

**RTO**

(FCom1 SP-30-3 Mar 03)

- ❖ Above 80kts – Do not reject solely for PVD failure.
- ❖ At 900m (3000ft) to go, C/L lights change to alternating Red/White, suggest speed should be ≈ 90kts.
- ❖ At 300m (1000ft) to go, C/L lights change to all Red. Suggest ≈ 30kts, (20 lights to go @15m spacing!)
- ❖ Caution Zone lights in last 610m (2000ft) of RWY indicated by yellow edge lights, (not all RWYs).
- ❖ Note: not all RWY's have colour coding altn red/white. See individual RWY plate.
- ❖ After RTO stay on RWY. Use ldg lights & strobes for location by emergency services.
- ❖ Use MAP display to advise on posn on RWY.
- ❖

**Transmissometers & AOM for T/O**

(FCOM1 SP-30-3 Mar 03)

**UK – T/O Limits**

- ❖ 3 transmissometers.
- ❖ TDZ + Mid-point at or above AOM.
- ❖ TDZ RVR can be over ridden by Captains assessment. (A[1] 8-1-3-2-2 Jun 08)
- ❖ Stop end advisory unless:–
  - \* State min
  - \* Operating with Capt PVD only (if PVD T/O)
  - \* Required by AOM
  - \* Even if advisory, close to MTOW, consider Stop End RVR anyway
  - \* May be used if Mid-point U/S. (A[1] 8-1-3-2-2d Jun 08)
- ❖ 75, 75, 75 would be OK for a PVD T/O at LHR; (150, 150, xxx if both PVDs u/s).
- ❖ Appropriate LVPs must be in force when RVR < 400m. (A[1] 8-3-0-2-2 Jun 08)

T/O min in UK			
Take Off	RVR		
	TDZ	Mid-point	Stop-end
Ceiling as AOM (Normally NIL) Minima (fully equipped R/W: RVR 75m)	AOM minima	AOM minima. May be U/S. Stop-end RVR may be substituted if mid-point RVR not available.	Advisory if 2 PVDs, otherwise AOM minima

**LHR T/O limits**

- RVR/Vis = 150m: PVD = 75m
- With a 15 m light spacing, should see 4 lights in RVR 75m, (5 lights less 1 cutoff).
- With a 15 m light spacing, should see 9 lights in RVR 150m, (10 lights less 1 cutoff).
- With a 30 m light spacing, should see 5 lights in RVR 200m, (200m is min RVR @ 30 m spacing).

**USA – T/O Limits**

(A[1] 8-1-3-2-2 Jun 08)

These are broken down into three sets of conditions. All with a Nil Ceiling.

**Visibility ¼ sm (approx 400m vis or RVR 1600ft). Requires:**

- HIRL or
- RWY centre line lights or
- RWY centre line markings or
- In DAYLIGHT, pilot has sufficient reference from the RWY markings to maintain directional control.
- Note: If TDZ RVR is available, this is controlling.  
Mid-point RVR may be substituted for TDZ.

**TDZ RVR 1200ft with Rollout RVR 1000ft. Requires:**

- RWY centre line lights AND
- 2 RVR reporting systems, both required and controlling, usually TDZ & Stop End/ rollout.
- Mid-point RVR can be substituted for TDZ or Rollout if either not available.

**TDZ RVR 600ft, Mid-point 600, & Rollout RVR 600ft. Requires:**

- RWY centre line lights AND centre line markings
- Must have TDZ & Rollout RVR, or 3 RVR reporting systems, with all three at or above AOM.
- If 2 or 3 transmissometers installed.
- If only 2 installed both must be serviceable, TDZ & Rollout are required and controlling.
- If 3 installed & 1 u/s, the 2 remaining must be above the required 600ft RVR.
- If RCLS installed, C/L light spacing is 50ft (15.25m), expect to see 10 lights with RVR 600ft. (PVD requires CAT 3, & afaics there are no PVD T/O limits for US A/F's). (N Atlantic Brief)

T/O min in USA				
Take Off	RVR			RWY Lts
	TDZ	Mid-point	Rollout	
Ceiling Nil Vis ¼ sm (RVR 1600ft)	1600ft	Not required	Not required	HIRL <i>or</i> CL LTS <i>or</i> CL Markings Day: Vis refs at all times
	Controlling if available	May be substituted for TDZ if not available		
Ceiling Nil. 2 RVRs required. TDZ RVR 1200f Rollout RVR 1000ft	1200ft	Not required	1000ft	CL LTS
	TDZ and Stop-end RVRs are controlling Mid-point may be substituted for TDZ or Rollout if either U/S			
Ceiling Nil. 3 RVRs installed. All segments 600ft	600ft	600ft	600ft	CL LTS <i>AND</i> CL Markings
	Any one may be u/s			
Ceiling Nil. 2 RVRs installed. All segments 600ft	600ft	600ft	600ft	
	TDZ and Stop-end RVRs required & are controlling			

## CANADA – T/O Limits

These are broken down into two sets of conditions. All with a Nil Ceiling.

### Visibility ¼ sm (or RVR 1200ft). Requires:–

- HIRL or
- RWY centre line (C/L) lights or
- RWY centre line markings.

### RVR 600ft. Requires:–

(Canadian Aviation Regulations 721 / A[1] 8-1-3-2-2 Jun 08)

- HIRL AND
- RWY centre line lights AND
- RWY centre line markings.
- Must have TDZ & Mid-point RVR reporting systems, both are required and controlling.
- If Mid-point RVR reporting systems u/s. Stop End RVR may be used and is controlling.

T/O min in Canada				
Take Off	RVR			RWY Lts
	TDZ	Mid-point	Rollout	
Ceiling Nil Vis ¼ sm (RVR 1200ft)	AOM	Not required	Not required	HIRL <b>OR</b> RWY CL LTS <b>OR</b> RWY CL Markings
	RVR reporting not specified			
Ceiling Nil. RVR 600ft TDZ & Mid-point RVRs required	600ft	600ft	Not required	HIRL <b>AND</b> RWY CL LTS <b>AND</b> RWY CL Markings
	TDZ and Mid-point RVRs are controlling		May be used if Mid-point U/S	

## All Weather Approach & Landing

### Instrument Approach Ban

(A[1] 8.1.3.2.12.3/5 Jun 08)

*Thou shalt not continue an approach below:*

- \* 1000ft aal (not radio alt) on a precision approach or
- \* FAF on a NPA or
- \* 1000ft if no FAF

*if, when arriving at that position:*

- \* TDZ RVR, or Visibility < minima
- \* Mid Pt RVR < 125m or TDZ minima if less (& if reported)  
Canada: < 600ft  
USA < 400ft or TDZ minima if less (when reported).
- \* Stop end RVR advisory but...when reported and if specified by AOM:–  
< 125m or TDZ RVR if lower  
USA < 400ft or TDZ minima if less (when reported and if specified by AOM).

- ❖ After passing 1000ft or FAF, RVR's advisory. (A[1] 8.1.3.2.12.2 Jun 08)
- ❖ Descent below DA without adequate visual references is prohibited. (A[1] 8.1.3.2.12.2 Jun 08)
- ❖ RVR deterioration below 1000ft point can be ignored, equipment failure cannot. Reversion decision is based on the RVR at 1000ft. Immediate G/A if the '1000ft point' RVR < reversion minima for the new condition.
- ❖ 'CAT 3B' & 'CAT 3B No DH' approaches require a LR RWY.
- ❖ PVD has no affect on RVR requirements. (FCom1 SP-30-4 Mar 03)
- ❖ **Important:– Cannot operate below Cat 1 limits unless LVP's are in force or RWY protected.**  
**Must use autoland if operating below Cat 1 limits.** In the US ask for Cat 2/3 protection. Tell them you need a coupled approach to an A/Land and ask for PAR monitoring (mandatory). (A[1] 8.3.18.15.9 Jun 08)
- ❖ CAT II/III minima may only be used if published in AOM.

### Auto Land Limitations

(FCom1 L-10-6 Mar 03)

Max Wind	Autoland	25 kts	
Max X-Wind	Autoland	25 kts	(USA 15 kts)
Max Tail Wind	Autoland	15 kts.	

Max X-Wind Autoland (CAT 1) 40 kts

G/S limits 3.25° to 2.5° (Note: only applies to A/Land)

(Note in 3 Fleets NL)

Note: TWC for MLW may be reduced compared with manual ldg ops. (see Performance Man).

A/Land cannot be made above Max Ldg Wt, except in emergency requiring immediate return.

### Reversion

(A[1] 8.1.3.2.12.2 Jun 08)

- ❖ A msg/ 'LAND 2' annunciated means revert to CAT 3A, (even in US). (FCom1 SP-30-5 Mar 03)
- ❖ If RVR < CAT 3A limits then have no reversion capability. If CAT 2 - no such thing as reversion, unless you count Cat 1.
- ❖ Lowest limits for Cat3/No DH = 75/75/0 (UK) with no reversion capability.
- ❖ Pre set reversion MDA 50R on PFD, press cancel button to blank display.

App CAT type	RWY type	Lowest Typical Limits			
		DH	RVR m (UK)	RVR ft (US)	RVR ft (Canada)
CAT 3 B No DH	LR only	0	75 / 75 / 0		
CAT 3 B	LR only	15R	75 / 75 / 0	300 / 300 / 300	
CAT 3 A	L or LR	50R	200 / 125 / 0	700 / 700 / 0	600 / 600 / 0
CAT 2	A*, E, L or LR	100R	200 / 125 / 0	1200 / 0 / 0	1200 / 600 / 0

Note: Cat 3B requires 15m C/L lighting. If 30 m spacing, RVR increases to 150m.

Also Cat 3B NO DH requires at least 1 RVR reading.

(Perf M. 4.2.4/5 Dec 99)

Cat 3B NO DH – If TDZ lights fail - no restrictions.

\*Cat 2 now approved for A (when approved), E as well as L & LR RWYs.

(A[1] 8.3.18.15.9 Jun 08)

**Transmissometers & AOM for Landing**

(A[1] 8.1.3.2.12 Jun 08 / FCom1 SP-30-4 Mar 03)

**General – Ldg**

- If TDZ RVR not available – use Mid Pt (if approved by the State). (Perf M. 4.2.5 Dec 99 / A[1] 8.1.3.2.12.4 Jun 08)
- RVR measured by human observer OK for CAT 2, 3A & 3B but see below... (A[1] 8.1.3.2.12.4 Jun 08)
- Cat 3B No DH A/Land requires at least one RVR transmissometer reading. (Perf M. 4.2.4 Dec 99)
- Factored met vis calculation only if AOM limits  $\geq 800\text{m}$  (i.e. CAT 1 or NPA) and RVR not reported. If RVR reported as “greater than 1500m”, then use factored met vis. (A[1] 8.1.3.2.7 Jun 08)

**UK – Ldg**

- **TDZ**  $\geq$  AOM; **Mid Pt**  $\geq 125\text{m}$  or TDZ minima if less; **Stop end** – advisory if AOM not specified.
- If Stop end AOM specified, then as per Mid-point.
- Min RVR’s (for all 3 specified segments) mandatory above FAF/1000ft point, then advisory. (A[1] 8.1.3.2.12.3 Jun 08)
- LHR ATC may give alleviation to land before 0602L noise ban when LVPs in force & ATC request to land before 0602L. (A[1] 8.3.21.8.2 Jun 08)

Landing		TDZ RVR	Mid-point	Stop End
UK	Cat 1	Any one may be U/S with no penalty. RVR from factored met vis or human observer OK.		
	Min $\geq 125\text{m}$	<b>125m</b> (If TDZ RVR u/s use Mid-point)	<b>125m</b> (if reported)	<b>Advisory</b> But if specified, 125m
	Min $< 125\text{m}$	<b>AOM</b> (If TDZ RVR u/s use Mid-point)	<b>AOM</b> (if reported)	<b>Advisory</b> But if specified, TDZ minima

**USA – Ldg**

(A[1] 8.1.3.2.12.5 Jun 08)

- **TDZ**  $\geq$  AOM; **Mid Pt** (when reported)  $\geq 400\text{ft}$  or TDZ minima if less; **Rollout** (If specified)  $\geq 400\text{ft}$  or TDZ minima if less
- Request PAR monitoring (Mandatory requirement).
- Min RVR’s mandatory above 1000ft AAL, then advisory. (NPA: use FAF or 1000ft AAL if no FAF).
- In US, no ILS protection if CC  $\geq 800\text{ft}$  &/or  $\geq$  Vis 2 sm. (AIM 1-1-10; NA Brief)

Landing	TDZ RVR	Mid-point	Rollout
USA NPA	<b>AOM</b> Required & controlling	<b>Advisory</b> (can be used for TDZ)	<b>Advisory</b>
USA Cat 1	<b>AOM</b> (Not less than 1800ft) Required & controlling	<b>Advisory</b> (can be used for TDZ)	<b>Advisory</b>
USA Cat 2	<b>AOM</b> (Not less than 1200ft) Required & controlling	<b>Advisory</b> Not required but can be used for Rollout	<b>Advisory</b> Required but advisory
USA Cat 3A RVR $\geq 700\text{ft}$	<b>AOM</b> (Not less than 700ft) Required & controlling	<b>400ft</b> Required & controlling	<b>Advisory</b> (If specified then 400ft) Required but advisory
USA Cat 3B ( $< 700\text{ft}$ ) RVR $\geq 300\text{ft}$	<b>AOM</b> (Not less than 300ft) Required & controlling	<b>400ft</b> or TDZ min if lower Required & controlling	<b>400ft</b> or TDZ min if lower Required & controlling
All reported RVRs $\geq$ AOM. One may be u/s without penalty			

**Canada – Ldg**

(A[1] 8.1.3.2.12.5 Jun 08 / Perf Man 4.2.6/7 Feb 00)

- TDZ  $\geq$  AOM; Mid Pt  $\geq 600$  (FCO 2326 Dec 05 no equivalent)
- Roll out advisory, (600ft if specified).
- 2 RVR reports ‘A’ & ‘B’: Operations banned if TDZ  $< 1200\text{ft}$  or Mid Pt  $< 600\text{ft}$ . (AERAD 50)
- 1 RVR reports ‘A’ or ‘B’: Operations banned if TDZ or Mid Pt  $< 1200\text{ft}$
- Min RVR’s mandatory above OM or FAF, then advisory. (CAA regs: use most restrictive of FAF or 1000ft).
- Request PAR monitoring (Mandatory requirement).

Landing	TDZ RVR ‘A’	Mid point RVR ‘B’	Rollout
Canada Cat 2	<b>AOM</b> (Not less than 1200ft)	<b>600ft</b>	<b>Advisory</b>
	If only one RVR reported, it must be $\geq 1200\text{ft}$ .		
Canada Cat 3	<b>AOM</b> (Not less than 600ft)	<b>600ft</b>	<b>Advisory</b>
	If TDZ not avail then use mid point 1200 ft (Check this)		

**RVR & Factored Met Vis**

(A[1] 8.1.3.2.7 Jun 08)

- ❖ If AOM limit is quoted as a Met Vis, factoring met vis not allowed.
- ❖ Factoring met vis to RVR not allowed for:
  - \* T/O
  - \* Calculating RVR limits < 800m
  - \* When an RVR is reported. (i.e. you can't cheat!)
- ❖ Exception to the above is that RVR may be reported as "More than 1500m". In this case consider it not reported & use factored Met vis instead. (A[1] 8.1.3.2.12.1 Jun 08)
- ❖ See factoring table below...
- ❖ Note about RVR: For any particular fog density, RVR will be significantly greater than reported visibility because RVR is based on the use of high intensity lights. Therefore RVR reports are only meaningful when on or near the RWY segment where the report was obtained (TDZ, MID, or Rollout). An RVR report has no meaning unless a pilot is also seeing the high intensity lights on which the report is based.  
RVR is a value that can be five to six times greater than ground or tower visibility at night and two to three times greater during daytime. (FAA Doc 8400.10 para 495)

**Approach with u/s facilities**

(A[1] 8.1.3.2.12.4 Jun 08)

- ❖ **Cat 1 ILS with u/s GP:** Use No GP/LLZ min. (FCO: 23?? Jun 05)
- ❖ **Cat 1 ILS with u/s OM:** Use normal ILS min, X- checking GP by other aids.
- ❖ **Lighting – Cat 1 ILS, PAR, or Non Precision App:** See table in FCPM Part A(1)
- ❖ **Lighting – Cat 2 or 3 ILS:** See table in FCPM Part A(1)
- ❖ **Transmissometers – Cat 1 ILS, PAR, NPA:** Not a requirement. Min unchanged. Use human observer or factored Met Vis.
- ❖ **Transmissometers – Cat 2/3:** RVR taken by human observer OK for CAT 2 or CAT 3A but not CAT 3B.
- ❖ **TDZ RVR not available:** Use Mid-point, if approved by the state.
- ❖ **RVR not available for approach** – use table below:  
For CAT 1 or NPAs only and except where the AOM limit is quoted as a Met Vis, factor met vis as follows:

Conversion of reported Met Vis to RVR		
Available Lighting	RVR=VIS x Factor	
	Day	Night
HI App & RWY Its	1.5	2.0
Any other lighting	1.0	1.5
No lighting	1.0	Not Authorised

Conversion table not to be used for:–

- ❖ Takeoff
- ❖ Cat II/III
- ❖ When reported RVR is available
- ❖ Planning purposes.
- ❖ **No RVR or Met Vis not available:** Capt's discretion to operate to DA. (A[1] 8.1.3.2.12.4 Jun 08)
- ❖ **Night landings:** min of RWY threshold, edge, & end lights. (i.e. ldg without RWY lights not permitted). (A[1] 8.1.3.2.10 Jun 08)
- ❖ Failure of grnd aids announced in the late stages of approach (after OM) may be disregarded at Capt.'s discretion.
- ❖ Failures, other than ILS failure, – have no effect on DH, only on the RVR.
- ❖ For Cat 2/3 ops, – a combo of RWY light deficiencies + RVR assessment equipment is not allowed.
- ❖ **CAT 3 No DH operations:** (PerfM. 4.2.4 Dec 99)
  - \* RVR - at least one RVR required (by transmissometer).
  - \* With no C/L lights, or no standby power to lights:
    - DAY – min RVR: 200m.
    - NIGHT – not permitted, (use CAT 2 with RVR 550m).
  - \* No TDZ lights - no restrictions.

**Approach Briefing & Preparation**

(FCom1 SP-30-3 Mar 03)

- ❖ Use the Flying Man as aid memoir as there no other checklist. (N McDowall / FCom1 SP-30-4 Mar 03)
- ❖ Check Performance Man for AOM, RLW and RWY status (L or LR). If RWY contaminated RLW is more restrictive for A/Land due to possible longer flare.
- ❖ If **actual** LDA < Performance Man LDA, do not A/Land unless approved. (Perf M. 4-1-3 Dec 99)
- ❖ Check A/Brake stopping dist to estimate turn off point on RWY. (G Radford)
- ❖ Emphasise use of F30 for auto-land (Flt Ops News Oct 07)

**Airfield**

(FCom1 SP-30-4 Mar 03)

- Check A/F operating to CAT 2/3. (ATIS/RT). Check AIS for CAT 2/3 items.
- In UK “Low visibility procedures in force” means ILS & RWY protected according to WXR conditions:–  
RVR between 400 & 600m – CAT 2  
RVR < 400m – CAT 3
- Most other countries may not understand ‘LVP in force’ statement, request CAT 2/3 protection.
- **In US: no ILS protection if CLG ≥ 800ft &/or Vis ≥ 2 sm.** (AIM 1-1-10; NA Brief)
- If TDZ RVR not available: use Mid-point.
- Advise ATC of intention to make Autoland to ensure priority.
- CAT 2 Ops RWY status must be A (if approved), E, L or LR. (A[1] 8.3.18.15.9 Jun 08)
- CAT 3 Ops RWY status must be L or LR. (A[1] 8.3.18.15.9 Jun 08)
- Check A/F lighting at 100% (as this may effect reported RVRs).

**Aircraft**

(FCom1 SP-30-4 Mar 03)

- Check EICAS Recall:–
- **NO LAND 3** = ILS CAT 3A (leads to LAND 2 on PFD)
- **NO AUTOLAND** = ILS CAT 1
- **SGL SOURCE DISPLAYS** }
- **SGL SOURCE RAD ALT** } MUST NOT BE DISPLAYED.
- **SGL SOURCE ILS** }
- **SLATS DRIVE** } (Which should generate a **NO AUTOLAND** ) (FCom1 L-10-7 Mar 03)
- Note also that the following gives a **NO AUTOLAND** msg: Pitch Up Authority, Flt Cntrl Mode, Prim Flt Computers, & Stabiliser msgs. Also with Dual Hyd Fails, or any Check list leading to < F20 ldg.
- A/Land cannot be made above MLW, except if emergency ldg imperative. (FCom1 L-10-7 Mar 03)
- Check MLW for A/Land in Perf Man especially if TWC.
- Use Autobrake, (symmetric braking, max tracking and min ldg dist).
- Set PVD if CAT 3 RWY. This will blank after test, but is armed for ldg if A/P disconnected for rollout. This is normally done in TOD brief. (Review?).
- Failure of one system will generally leave you with **LAND 2** e.g. Hyd sys; Rad Alt.  
Failure of two systems will generally leave you with **NO AUTOLAND**.

**Commencing approach**

(FCom1 SP-30-3 Mar 03)

- ❖ On first contact with approach controller request CAT 2/3 approach and give min RVR.
- ❖ Request 10 nm final. (A[1] 8.3.18.15.9 Jun 08 & FCom1 SP-30-4 Mar 03)
- ❖ Advise Tower making CAT 2/3 approach. Tower will advise if protection not available.
- ❖ Capt.’s responsibility to ensure sensitive areas clear of other A/C.
- ❖ In USA/Canada PAR monitoring mandatory.
- ❖ For RVRs below 600m landing lights are not recommended.



## Final Approach & Landing

(FCom1 SP-30-4 Mar 03)

- ❖ At 1500R remaining 2 A/P's engage: **LAND 3** with Flare & Rollout armed should be annunciated.
  - \* Request latest RVR, discuss reversion to CAT 3A, (200 RVR typical).
- ❖ At 1000R (Auto call)
  - \* Check **LAND 3**, **LAND 2** or **NO AUTOLAND** annunciations, (May not happen until 500R).
  - \* If RVR @ 1000ft point  $\geq$  relevant min, Capt takes control, else calls "G/A", F/O flies G/A.
  - \* If LAND 2 annunciated revert to CAT 3A. (This can be pre-set in most cases).
  - \* Rad Alt changes to clock presentation. Cannot set DH below 990R. (TM[FC2] 10-30-03 Apr 03)
- ❖ At 500R
  - \* P2 (PF) monitors "500" call (if fitted), and calls "Stable" or "Go around".
- ❖ Below 500R
  - \* RWY align sub mode engages if crab  $> 5^\circ$ , no annunciation.
  - \* ILS deviation active. In Cat 3, manual G/A if persistent ILS deviation occurs.
  - \* If **LAND 3** or **LAND 2** not annunciated – immediate G/A.
- ❖ At 200R (Alert Ht)
  - \* **NO LAND 3** msg and **LAND 2** annunciations are inhibited.
  - \* No auto bus isolation.
  - \* If no LDG clearance received by 200R – G/A. This covers ATC requirement to give clearance by 300ft / 1nm and the possibility they forget. (A[1] 8.3.18.15.9 Jun 08)
- ❖ Below 200R
  - \* Auto calls 100, 50, 30, 20, 10, 50 Above, & Decide, ('50 Above', & 'Decide' take precedence).
  - \* No '50 Above', & 'Decide' calls if a 'No DH' A/Land.
  - \* Capt remains on instruments until 50 above DH.
  - \* Immediate G/A (press the TOGA btn for Auto G/A) for:–
    - No vis contact (except if 'No DH' approach).
    - Visually not aligned
    - ILS deviation warning
    - Master Caution / beeper with one of these EICAS caution msgs, (when below 200R & below CAT 1 WXR):–
      - AUTOTHROTTLE DISCONNECT** (man thrust for G/A!!!),
      - SPEEDBRAKE EXTENDED**
      - NO AUTOLAND**
      - AUTOPILOT** (except in flare and have vis references – OK to land).
  - \* Master Caution / beeper is inhibited for all other warnings, but EICAS msgs still displayed. (QRH MAN-80-1 May 07)
- ❖ 50R Flare mode commences.
- ❖ 25R Retard mode. If manual A/T, close T/Levers @ 25R.
- ❖ <2R Rollout engages.
- ❖ For **LR** RWY disconnect A/P at safe taxi speed (otherwise can't steer A/C).
- ❖ For **L** RWY disengage A/P after nosewheel touch down. Use PVD.
- ❖ For **B** RWY disengage A/P @ 100R.
- ❖ If no LAND 3 or 2 disengage A/P @ 200 agl. (FCom1 L-10-7 Mar 03)

Note: During LAND 2/3 ILS approaches, Runway Alignment sub-mode is active, which applies rudder to reduce the crab angle at 500 ft and/or 200 ft AGL. When the A/P is disengaged, the rudder moves to the trimmed position. HP may need to adjust rudder pedal force when the A/P is disconnected. (FCom1 NP-70-10 Jun 10)





**Visual References at DH**

(A[1] 8.1.3.2.9 Jun 08)

CAT type	Lts	Vis References
CAT 3 B No DH	0	Nil
CAT 3 B	1	At least 1 C/L light. <i>(Only case can continue if loose vis refs).</i>
CAT 3 A	3	<b>At least 3 consecutive lts. Any combination of C/L approach lts, TDZ lts, RWY C/L lts or RWY edge lts.</b>
CAT 2	3 + lateral	As Cat 3A but must include a lateral element, either app X-bar, threshold, or TDZ barrettes.
CAT 1, PAR, NPA, visual.		Distinctly identify one of:- App lts segments, Threshold markings or lts, TDZ markings or lts, VASIs, or RWY markings or Edge lts.

- ❖ When not coupled to G/S, (i.e. manual approach) – vis reference must be established sufficiently before DH to confirm the descent path is maintained. About 3 secs or 30ft is sufficient.
- ❖ Loss of visual references requires immediate G/A, except for ILS Cat 3B. *(FCom1 SP-30-6 Mar 03)*
- ❖ Note that RVR's are dependent on 100% lighting. If you ask for dimmer approach lights then RVR may also fall. If RVR's appear low ask if lights are at 100%.

**A/P disconnect**

(A[1] 8.3.18.15.9 Jun 08)

Procedure	R/W Status	Lowest Disengage Ht	Notes
ILS	LR	A/Land	
ILS	L	A/Land	Disengage after T/Down. In CAT 1 can leave A/P for evaluation.
ILS	B	100R	
ILS	E	A/Land	Evaluation: Cat 2 only or CAT 1 if ILS not protected.
ILS	ANY	200R	LAND 2 or 3 NOT annunciated.
NPA	ANY	MDH-50ft	Not coupled to LOC and G/S.

**After Landing**

(FCom1 SP-30-6 Mar 03)

- ❖ For LR RWY – A/P & A/Brake can be used to a full stop.
- ❖ For L RWY – CAT 2/3 conditions: disengage A/P after nosewheel touchdown, as roll out not assured.  
– CAT 1 conditions: A/P can be used to evaluate rollout.
- ❖ Disconnect A/P to recover use of nose wheel steering.
- ❖ PVD will operate when A/P disconnected.
- ❖ Taxi lights are green yellow until outside LSA (LOC Sensitive Area). (Is this UK only?).
- ❖ Ldg dist longer for A/Land due to longer flare. This depends on G/S angle & height @ threshold. *(PerfM. 4-1-3 Feb 97)*
- ❖ At 900m (3000ft) to go, C/L lights change to alternating Red/White, suggest speed should be ≈ 90kts.
- ❖ At 300m (1000ft) to go, C/L lights change to all Red. Suggest ≈ 30kts, (20 lights to go @15m spacing!)
- ❖ Caution Zone lights last 610m (2000ft) of RWY indicated by yellow edge lights.

**Taxi In & Shutdown**

- ❖ Do not call vacated, till clear of protected area.
- ❖ Tech log AWO box required if A/Land in < 800m TDZ RVR or < 200ft vis ref. *(T. Log User Man)*
- ❖ A/Land report.

**Auto Go Around & TOGA**

(TM[FC2] 04-20-17 Apr 03 / FCom1 NP-60-14 Mar 03 / 02-SP-30-7 Mar 03)

- ❖ TOGA mode armed when Flaps away from UP, or at G/S Capture, until 2 secs after 5R.
- ❖ During automatic G/A, less than 50ft of altitude will be lost.
- ❖ Automatic go-around cannot be initiated after touchdown.
- ❖ Speed is controlled to a max of IAS/MACH window speed + 25kts.  
If current speed > target speed for 5 sec, target speed is reset. (TM[FC2] 04-20-17 Apr 03)
- ❖ The TOGA roll mode maintains existing ground track.
- ❖ **Call 'G/A Flap 20' or 'G/A Flap 5'** (Only use F5 for G/A if QRH tells you).
- ❖ **Press the TOGA btn.** (If Manual G/A you need to pull!)
- ❖ One push = derated G/A. (Climb limited to 2000ft/min).  
Second push gives full G/A thrust.
- ❖ Positive climb, retract gear. Above 400ft, select LNAV or HDG SEL/TRK SEL.  
Note: A/P rudder control is lost when another pitch or roll mode is selected.  
TAC will provide yaw control, (if serviceable).  
(If accidentally press VNAV, press TOGA again to regain mode, rather than V/S - can't use FLCH).
- ❖ At Aa, set the speed bug to Vref30+ 80. When flaps are up and speed is at Vref + 80, select FLCH or VNAV. The thrust limit reduces to CON or CLB, (or use CLB/CON btn).
- ❖ At selected altitude pitch changes to ALT, but A/T remain in THR until SPD selected.  
Roll remains at TOGA until another mode (LNAV, HDG) is selected.  
Note: if ALT capture occurs (or if V/S or FPA engaged) whilst in TOGA mode, the MCP is speed automatically set to:-
  - \* flap placard speed minus 5kts,
  - \* 250kts if flaps are up or
  - \* speed value entered into IAS window after TOGA pushed.
- ❖ Bus isolation terminates at TOGA initiation.
- ❖ For CAT 2/3 RWYs the WAT limit is lower than for CAT 1 RWY due to more restrictive G/A performance.  
Caution: If VNAV is selected at low altitude (above 400ft aal) and the active waypoint has an altitude constraint below the aircraft, VNAV ALT is annunciated and the A/C will descend.
- ❖ With eng out, do not use FLCH until flaps up & speed at or above Vref30+80. (FCom1 L-10-6 Mar 03)  
This because FLCH sets CON power and G/A power actually required.

**TOGA Mode Termination**

(FCom1 SP-30-7 Mar 03)

- ❖ Below 400ft – Autopilot must be disengaged & both F/D's turned off.
- ❖ Above 400ft – Any pitch or roll mode can be selected, apply rudder if required.
- ❖ On landing – 2 sec after 5R.

## All Weather Non - Normals

(QRH MAN-80-1 May 07)

### A NO LAND 3 (Message) + LAND 2 (Annunciation)

Means a single failure in the A/P system & loss of fail-operational capability. An A/P channel may disengage. A further fault may cause a total A/P disconnect.

**Revert to Cat 3A minima. (3 lights & 50R + 200/125/0)**

Below 200R, a single failure is NOT annunciated until G/Spd < 40kt & A/P disengaged.

A **NO LAND 3** EICAS message is displayed. Annotate the Tech Log with 'NO LAND 3 Recall'.

### A NO AUTOLAND (Message and/or annunciation)

A significant loss of A/P capability or lack of multi-channel engagement.

Revert to CAT 1, If <1000R continue only if **visual** & > CAT 1. **During CAT 2/3 – immediate G/A.**

### EICAS Cautions below 200R

(QRH MAN-80-1 May 07)

**Immediate G/A** for any Master Caution Light with EICAS caution message whenever:–

- ✱ the actual weather is below Cat 1 minima, and when below 200R.

Cautions not inhibited below 200R are:–

(see MEL 09-01-01-xx)

- ✱ **AUTOTHROTTLE DISCONNECT** – Auto or man disconnection of A/T
- ✱ **SPEEDBRAKE EXTENDED** – S/Brake beyond ARM, F25/30, & height between 800 & 15R
- ✱ **AUTOPILOT** – A/P operating in degraded mode, roll/pitch mode failed, or in envelope protection.
- ✱ **NO AUTOLAND** – A/Land lost after LAND 2/3 annunciated or no engagement by 600R.

See below for A/P disconnects. If A/P fails <200R it may not be obvious to PF that the A/P has disconnected despite the warning horn. TOGA will not rotate the A/C as expected. Need to make positive rotation. Rad Alt counting down will be a major clue!!!!

### No PFD Annunciation by 500R

(QRH MAN-80-2 May 07)

If no PFD annunciation of **LAND 3**, **LAND 2** or **NO AUTOLAND** by 500R there is significant loss of A/P capability. A/Land must NOT be attempted. **During CAT 2/3 – immediate G/A.**

### ILS Deviation.

Active below 500R; PFD LOC & G/S scales go amber & pointer flashes.

Above 200R – monitor the tracking, If not returning or alert is persistent; – **immediate G/A.**

Below 200R – **immediate G/A.**

### Autopilot Disconnect (Cat 2/3 approaches)

(QRH MAN-80-2 May 07)

For a total A/P disconnect during a Cat 2/3 approach – **immediate manual G/A**, even if below DH.

Caution – A/C could be significantly out of pitch trim.

If the A/P disconnects, the Captain may complete the landing manually, provided:–

- ✱ the disconnect occurs after the flare has commenced **and**
- ✱ there is sufficient visual reference to land manually.

### Autothrottle Disconnect

(QRH MAN-80-2 May 07)

Above 200R: A/T recommended. If manual A/T used, close T/Levers at 25R, to reach idle at T/Down.

Below 200R: An A/T disconnect <200R gives a caution msg. – **immediate G/A.**

Manual thrust for G/A!!!! Don't forget to reduce thrust at G/A height.

### Generator Failure

(QRH MAN-80-2 May 07)

Above 200R, – a single failure automatically reconfigures bus isolation.

Subsequent failure gives a **NO LAND 3** msg / **LAND 2** annunciated & loss of associated A/P.

Below 200R, – system will not reconfigure, may lose A/P channel. Failure NOT annunciated until

G/Spd < 40kt & A/P disengaged. A **NO LAND 3** EICAS message is displayed.

Annotate the Tech Log with 'NO LAND 3 Recall'.

### ILS Failure

(need more info on this.)

If TX fails - pointers disappear. A/C maintains flt path for short while then A/P's drop out. If RX fails - flags appear. Expect

**SINGLE SOURCE ILS** caution msg.

**Engine fail during Approach**

(QRH MAN-80-2 May 07)

- ❖ Use **Normal CAT 3 Ldg Min.** (Normal 1 Eng INOP procedures - no G/A required).
- ❖ Above 1500R – use manual rudder (if the TAC is inop) until multichannel engagement.
- ❖ Below 1500R – A/P controls rudder within acceptable limits.
- ❖ Slip manoeuvre starts at 1300R. At the 1000R check may see this slip applied as Align mode has started.
- ❖ If no A/T, smoothly apply power. During flare, reduce power slowly – A/P takes time to counteract induced yaw.
- ❖ For a G/A, TOGA mode is available, with some initial yaw. A/P quickly compensates and maintains ground track. When the A/P goes to single channel operation, rudder input required if the TAC is u/s.
- ❖ Eng fail - F20 ldg use F5 for G/A.

**Flap Problems**

(FCom1 L-10-7 Mar 03)

A/Land approved for:–

- \* Flap 20 or 30. (Note: not approved for F25)
- \* Single eng (F20) or both engs (F30) operating
- \* Must have **LAND 2** or **LAND 3** annunciated.

(R Izon)

**SLATS DRIVE** msg must NOT be displayed.(If have **FLAPS DRIVE** msg and F20 is set, A/Land is OK).

(AS)

**Capt Incapacitated on CAT 3 approach & does not respond to Decide.**

(QRH MAN-80-3 May 07)

- ❖ Safer for F/O to complete autoland in CAT 3 conditions than G/A. (A[1] 2862 Dec 05)
- ❖ If Capt incapacitated anytime after TOD then co-pilot continues to autoland provided planning to land at destination below CAT 1 and A/C is CAT 3 equipped.

**G/A MANDATORY for CAT 2/3 if:–**

- ❖ **NO AUTOLAND** msg,
- ❖ no **LAND 3**, **LAND 2** or a **NO AUTOLAND** annunciation by 500R,
- ❖ A/P disconnect, even below DH, (unless in late flare & visual),
- ❖ ILS deviation < 200R,
- ❖ below 200R and a Master Caution/beeper with any of the following msgs not inhibited:–
  - \* **AUTOTHROTTLE DISCONNECT** – (Man thrust for G/A!)
  - \* **SPEEDBRAKE EXTENDED**
  - \* **NO AUTOLAND**
  - \* **AUTOPILOT**

- ❖ Note: Can only continue with an approach if **visual**.

(FCom1 NP-10-7 Mar 03)

**Defect Reporting**

(QRH MAN-80-3 May 07)

Integrity defects e.g. a **NO LAND 3** message, should be reported as follows:–

- \* PFD annunciation – **LAND 2** or a **NO AUTOLAND**
- \* Height of occurrence
- \* Associated flight deck effects if any (e.g. Left Radio Altimeter Failed)
- \* Report all 'NO LAND 3 recalls' which occur below 40kt on rollout.

Report Performance defects as follows (with reasons):–

- \* Performance unsatisfactory for A/Land in < 200m. Downgrade A/P to LAND 2.
- \* Performance unsatisfactory for A/Land but satisfactory for auto-approach to 50R. Downgrade to NO AUTOLAND.

Note:– Status cue is inhibited below 800R until &lt; 75kts during Ldg.

(TM[FC2] 15-20-42 Apr 03)

EICAS msg displayed for any fault which limits capability of A/Land system. Aural alerts for EICAS msgs NOT affecting safety are inhibited till after T/Down. Changes to A/Land status below 200R are inhibited except change to NO AUTOLAND status.

(TM[FC2] 04-20-05 Apr 03)

**AWO Report Form**

(A[1] 8.3.18.15.11 Jun 08)

Required if:–

- ❖ T/O with RVR < 400m (Approx 1300ft)
- ❖ LDG (even if manual LDG or G/A) when:–
  - \* DH < 200ft and/or
  - \* RVR in any segment < 800m (approx ½sm)
- ❖ AUTOLAND on 'E' RWY
- ❖ Unsatisfactory AUTOLAND performance entered into the tech log
- ❖ Capt deems necessary.



# 8 • Ice/Rain/Wind

## Effects of ICE & Procedures

### Icing Conditions

(FCom1 SP-16-1 Jan 09)

#### Icing Conditions Exist when:-

TAT at or below 10°C, AND:-

- visible moisture present, **OR**
- when snow, ice, standing water present on ramps, taxiways, or RWY.

#### Visible moisture defined as:-

- Cloud,
- Fog with vis < 1500m, (approx 1 sm),
- Rain, snow, sleet or ice crystals.

EAI ON after engs started, when icing expected during taxi, T/O or immediately after T/O.

(FCom1 SP-16-5 Jan 09)

(Although the AUTO setting would cater for EAI after rotation, the A/T are in HOLD till 400R, hence putting EAI to ON will provide the thrust correction)

(Gary Carfoot)

If TAT > 10° – **ANTI-ICE ON** advisory msg displays, set EAI to AUTO.

### Freezing Fog Conditions

(FCOA 7 Sep 01)

- ❖ Under FZ FG conditions, check the rear of the fan blades for ice, prior to start. On arrival at LHR /LGW inform Tech Control that the rear of the fan blades should be checked.
- ❖ Freezing Fog: characterised by rime ice forming on the windward side of cold metal objects (a/c steps) or the a/c. However, temps below zero and visibility below 1000m does not constitute Freezing Fog. In the UK, FZ FG broadcast on the ATIS, does not necessarily mean that FZ FOG has been observed but simply that the temp < zero and it is misty or foggy.

### Clear Ice formation

(FCOA 8-4J Oct 03)

Upper & under wing surfaces near fuel tanks vulnerable to clear ice when:-

- \* Wing temps well below zero during turnaround,
- \* Ambient temp between -2° & +10°C,
- \* PPN present or high humidity (2° split in OAT/DEW Pt). (A[1] 2947 Apr 06)
- ❖ Low wing temps normally occur with large quantities of cold fuel in wing tanks during the turnaround and when any fuel uplift is insufficient to increase the fuel temps.
- ❖ Clear ice is extremely difficult to detect. When clear ice may have formed, make a close inspection of upper wing surfaces. After treatment, make a further close inspection.

### Preflight

(FCom1 SP-16-1 Mar 05)

- ❖ Contaminated RWY CARD.
- ❖ Derated thrust OK except if RWY slippery or contaminated with snow, slush, standing water. (PerfM. 5.1.5 Feb 97)
- ❖ For short shuttle flts, consider taking excess fuel to bring C of G fwd, to increase load on nosewheel & improve steering ??? (SFE Mike Foley)
- ❖ Check return altn ldg performance. Can you do a SE ldg at departure A/F if RWY contaminated? Yes, but not if Slippery.

### - 40 Second Sector Fuel

(FRM p112 Dec 95 / FCom1 NP-50-9 Mar 03)

- ❖ Where -47°C fuel is loaded after a -40°C fuel sector, assume mixture freeze point = -42°C.
- ❖ CWT tank fuel not affected by temp considerations.
- ❖ See also Section 8.6 Fuel Freezing.

### APU Start & Pack Operation

(FCom1 SP-16-1 Mar 05)

- ❖ APU door must be free of snow/ice & unobstructed prior to APU start. In heavy snow this can be a problem.
- ❖ Indication of APU inlet icing – High EGT, low duct pressure.
- ❖ Condition of APU battery and operation of battery heater more critical in cold WXR.

## External Inspection

(A[1] 8.2.4.1 Jun 08 / FCom1 SP-16-2 Mar 08)

- ❖ Protective covers – all removed,
- ❖ APU door area clear & free of impacted ice/snow prior to APU start.
- ❖ Wings, tail & control surfaces free of frost, ice, snow. except:– (A[1] 8.2.4.1 Jun 08)
  - \* Underside of wing – 1/8” or 3mm frost allowed in general area of the fuel tanks,
  - \* Fuselage – Thin Hoar Frost allowed provided vents & ports are clear.
  - \* N.B.: ice ridges under the wing are not acceptable, e.g. those formed by snow melt re-freezing.
- ❖ Pitot heads, static ports, angle of attack sensors clear. Water frozen in front of static ports will cause disturbed airflow, even though port itself is clear.
- ❖ Engine inlets clear. Check EPR sensors & check for ice behind the fan blades (especially if freezing fog has been present).
- ❖ **Ensure fan is free to rotate. A fan bonded to the casing can cause extensive damage to the engine on start up.** (Get engineer to ensure rotation – due ice melt freezing at bottom of fan). (A[1] 8.2.4.1 Jun 08)
- ❖ Air Conditioning inlets & outlets clear. Check outflow valves clear.
- ❖ Ldg gear, gear doors & wheel bays unobstructed & free of contamination.
- ❖ Fuel Tank Vents clear.
- ❖ Radome snow removed. (Prevents blow back on to windscreen during T/O).

### Defn Hoar Frost.

(A[1] 8.2.4.1 Jun 08)

Uniform white deposit of fine crystalline texture, which usually occurs on cold, cloudless nights, and thin enough to see surface features underneath (paint lines, lettering etc.).

Do not confuse with rime ice, which can form on windward surfaces in FZFG, this is NOT acceptable.

### Defn Freezing Conditions.

(FCOA 8 Oct 03)

OAT < 3°C & visible moisture (vis < 1500m or PPN).

A/C surfaces may fall to 4° below ambient (clear nights). Hence frost when OAT is +4°C or below.

See also <http://aircrafticing.grc.nasa.gov/>

## Record Anti-Icing code - Tech Log Entry

(A[1] 8.2.4.1 Jun 08)

Endorse tech log ‘PDC less de-icing’.

(FCOA 7 -11B Oct 03)

Enter the anti ice code in the Grnd de-/anti-icing box on the OUTGOING sectors yellow page, (i.e. the one you sign at destination), after every de-icing, even if done before crew arrive.

Tech log entry not required where ‘local area’ or under wing de-icing is carried out.

(FCOA 7 -13D Oct 03)

Ex: TYPE II/75/0730 or TYPEIV/1130/26DEC (Conc not req for TYPE 1 fluid). 3 mandatory elements + 2 optional.

## Snow Covered Fields (T/O & Ldg)

(FCom1 SP-16-6 Mar 06)

- |                   |  |                       |
|-------------------|--|-----------------------|
| Max Depth for T/O | 2.3” (60mm) Dry Snow. (Tends to exist with OAT <–5°C)<br>½” (13mm) Wet Snow/Slush. |                       |
| Max Depth for Ldg | 4” (10cm) Dry Snow. (Tends to exist with OAT <–5°C)<br>½” (13mm) Wet Snow/Slush.   | (PerfM. 4.1.4 Feb 97) |
- ❖ Personal inspection recommended if in doubt.
  - ❖ If in doubt whether it is snow or slush, & air temp > –5°C, use slush. (PerfM. 5.1.5 Feb 97)
  - ❖ 60mm dry snow is equivalent to ¼” standing water: conservative compared to Boeing figures.
  - ❖ If RWY slippery cannot return to departure A/F, (requires two reversers). T/O Altn required.  
Altn limits in USA (60mins - 400nm radius). If braking action degraded, then can land back at departure A/F, see QRH (SE pages).

## Snow Banks (T/O & Ldg)

(FCom1 SP-16-6 Mar 07)

- ❖ Min cleared width, cleared of deep snow/slush, 150ft (45m). LHR RWY’s 45m wide.
- ❖ Snow Banks:–
  - \* 75ft (23m) from RWY C/Line (150ft width)— 1½ft (0.45m)
  - \* 95ft (29m) from RWY C/Line (190ft width)— 2½ft (0.76m) – Uniform increase from 1½ft.
  - \* 110ft (33m) from RWY C/Line (220ft width)— 5.0ft (1.5m) – Uniform increase from 2½ft.
  - \* Remaining horizontal to 150ft (45m) from C/L.
  - \* CAT 2/3 – Published RWY width must not be reduced by snow banks.  
– Snow banks next to RWY edges not > 2½ft

## CARD

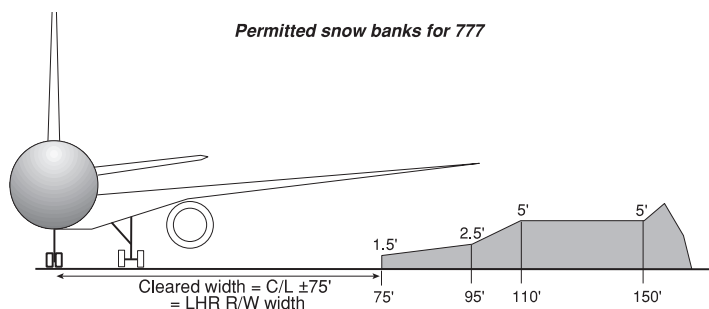
(PerfM. 3.2.2 Jun 99)

Do not select more than one contamination code (standing water, slush etc.).

Do not select Braking Action codes when using contamination code (can’t use two codes at once).

Get a ‘quote’ with each code and use the lowest RTOW, (i.e. use worst case).





## FICO / ACARS De-icing codes

FICO: De-icing state of A/C use: DICE <REG> where **REG** is the last 3 letters of registration.

ACARS free text use: •FIC ICE\_REG in body of message.

Note: at LHR this is the only way you can get the info - Tango tech doesn't have the info.

Deicing code is normally passed over the headset. For localised spot/wing de-icing, no code is required & no HOT. (Flt Ops News Oct 09)

## External De-icing Fluids

(A[1] 8.2.4.9 Jun 08)

**ISO Type I (Un-thickened):** High glycol – low viscosity (Min 80% glycol). Good de-icing performance but ineffective for anti-icing and very limited HOT, mainly as a result of heating up A/C skin. Increasing the concentration, does not increase the HOT. Used as 1st of 2 steps, or if ppn has ceased.

**ISO Type II (Thickened):** Medium glycol – high viscosity (Min 50% glycol). Good de-icing performance and protection provided against freezing ppn. Stays on surfaces longer, hence longer HOT. Max HOT provided by neat, undiluted fluid.

**ISO Type IV (Thickened):** Similar to Type 2. Advanced thickener, gives longer HOT.

### One Step De-icing/Anti-icing

- \* General deicing treatment.
- \* Areas treated with hot 50/50 or 75/25 mix are left with a coating that provides anti-icing with a HOT.
- \* Overnight anti-frost treatments are usually one-step treatments.
- \* If A/C is clean, & ppn or frost expected, can use cold 100% fluid. HOT is the same as a 2 step application.

### Two Step De-icing/Anti-icing

- \* Step 1 De-ices (removal of ice etc.) with hot mix fluid, Step 2 Anti-ices (protection), with cold 100% mix. Provides max HOT.
- \* The 2nd step must be carried out before 1st step freezes, & should be completed area by area.
- \* Anti-icing code determined from the 2nd step fluid. (A[1] 8.2.4.5 Jun 08)
- \* Enter in T/Log, on outgoing page, as TYPE/CONC/TIME (Local) (Type II/100/0639). 3 mandatory elements + 2 optional. (A[1] 8.2.4.1 Jun 08)
- \* At LHR/LGW access FICO by DICE <REG>. (Tech log entry is required @ LHR/LGW). (Don't ask Tango Tech - they don't know - use ACARS)
- \* ACARS: FIC ICE\_REG)

### Hold Over Times (HOT)

(A[1] 8.2.4.5 Jun 08 / FCOA 8-8 Oct 03)

- \* Hold over times are a guide only. You can still takeoff outside these times provided there are no frozen deposits.
- \* With 1 step de/anticing HOT begins @ start of de-icing operation (in ppn).
- \* With 2 step de/anticing HOT begins @ start of 2nd anti-icing operation (in ppn).
- \* When A/C has been de-iced in anticipation of freezing PPN, HOT does not start until PPN exists.
- \* HOT is extended if PPN is intermittent. Capt's judgement required. (A[1] 8.2.4.5 Dec 08)
- \* Lower limit is estimate for Moderate PPN, or FZFG, vis approx < 50m, (A[1] 2812 / FCOA 8-8 / 7-14B Oct 03)
- \* Upper limit is estimate for Light PPN, or FZFG, vis approx 200m,
- \* HOT effectively has expired when frozen deposits form on A/C surfaces.
- \* HOT can be shortened below lowest quoted HOT by:
  - Heavy ppn rates, or ppn with high moisture content,
  - Skin temp significantly < OAT, (e.g. fuel tanks with significant quantity of very cold fuel).
  - High winds/jet blast degrading protective film.
- \* At the end of the HOT, visually inspect wing, just prior to T/O. Further de-icing only required if frozen deposits have formed.
- \* Defn: Heavy Snow: severely restricts visibility & is settling rapidly.
- \* Mechanism is for ppn to dilute the anti-icing fluid over the HOT. Fluid shears off the wing during T/O giving an aerodynamically clean wing at rotate.
- \* Note - a 1/16" of ice on upper wing can increase stalling speed by 30%, and one wing may possibly stall before the other.
- \* If clear ice present, A/C surfaces must be inspected after de-icing. (FCOA 7-11B 10 Oct 03)
- \* **No HOT has been established for heavy snow, snow/ice pellets, hail, mod/heavy freezing rain. A pre takeoff ice check is mandatory.** (A[1] 8.2.4.5 Dec 08)
- \* At LHR /LGW: from 2008/09 fluid is Kilfrost ABC-S Plus, a high perf type IV fluid. Better hold over time and less gel build up. It is coloured bright green! If using ABC-S (no plus), use generic type IV HOT tables. (Flt Ops News Oct 08)
- \* Note: HOT clock does not stop if PPN stops, but HOT may be extended. (Flt Ops News 26 Jul 09)

## De-icing Precautions

(FCOA 7 &amp; 8 Oct 03)

- ❖ Packs and APU AIR must be OFF, but engines / APU may be running during de-icing, (except if using Kilfrost RDF which is flammable - shut down engs / APU).
- ❖ Flaps UP (prevents hot fluid washing out lubricants in bearings / actuators). (FCOA 8-4M Oct 03)
- ❖ All doors/hatches closed, (OK to start de-icing if door 1L open, see reference). (A[1] 8.2.4.1 Jun 08)
- ❖ Contamination of windscreen by Type II & IV fluids tend to smear the screens. (W/screen wipers exacerbate the problem).
- ❖ Remove significant contamination. Also ensure forward area (radome) is free of fluid to prevent blow back onto windscreen. (FCOA 7-11B-7 Oct 03)
- ❖ A/C must be de-iced symmetrically. i.e. same fluid mix and same areas both sides even if there are no deposits of snow etc. in some areas. No requirement for symmetric treatment on local under wing areas. (Flt Ops News Oct 08 / FCOA 8-4C Oct 03)
- ❖ Local area de-icing on upper wing. Must de-ice both wings symmetrically, even if frost only on one wing. No HOT times apply. (FCOA 8-3 Oct 03)
- ❖ Minimise fluid entry into engines, other intakes/outlets, control surface cavities, wheel well and on to landing gear. Especially the APU intake leading to smoke in cabin/ft deck.
- ❖ De-/Anti-icing fluids must not be sprayed directly into probes and vents or onto sensors, drains, windows, hot wheels/brakes, eng exhaust, or reversers.
- ❖ When a/c exposed for long periods in conditions which could restrict flight controls, thoroughly exercise controls after de-/anti-icing has been completed. (FCOA 8-4-I Oct 03)
- ❖ Under no circumstances can an A/C anti-iced with concentrate (100%) Type II or IV fluid receive a further coating of such fluid directly on top of the existing film, (makes the fluid too thick). Make a complete re-application.  
Do not ant-ice gear with concentrate type II or IV fluids.
- ❖ Some fluids are flammable & not suitable for use if engs running, e.g. Kilfrost RDF.
- ❖ For de-icing on remote stands see ops manual for further advice.
- ❖ Before taxi from de-icing pad, ensure all vehicles/personnel are clear. (FCOA 7-11B Oct 03)

## Engine Start

(FCom1 NP-30-30 May 07 / FCom1 SP-16-5 Jan 09)

- ❖ Initial oil press may be slow to rise & be higher than normal.
- ❖ Additional warm up time may be required for oil temps to reach normal range.
- ❖ Oil press indications may appear less bright. Accurate display of eng indications may take additional warm up time.
- ❖ Oil press indications may blank if oil pressure exceeds normal range. Nuisance STATUS msg **OIL PRESS SENSORS L/R** may be displayed. Display returns when oil temp increases and pressure decreases.
- ❖ **If no Oil Press after EGT rise, shut down.**
- ❖ **ENG OIL FILT L/R** msg may be displayed?
- ❖ EAI on after both engs started, with the 'After Start' procedure. (G Leask)
- ❖ Do not operate engine anti-ice when TAT >10°C, (**ANTI-ICE ON** advisory msg).

### RR Trent

(FCom1 L-10-6 Jan 09)

- \* Min oil temp for start – 40°
- \* Min oil temp for acceleration to T/O power 50° C

## De-icing with Engines / APU Operating

(FCom1 SP-16-4 Mar 08 / A[1] 8.2.4.1 Jun 08)

Engine A/Ice.....	ON (If required)
PACK Switches.....	OFF
(Wait 10 secs before switching bleeds off – reduces wear)	
ENG BLEEDS.....	OFF (If eng running)
APU BLEED.....	OFF (If APU running)
T/Levers.....	CLOSED (reduce chance of injury to grnd staff)
Flaps.....	UP (prevent ice/slush in flap/slat cavities)

- ❖ Wait 1 min after de-icing before restoring bleeds & packs.
- ❖ If contamination in area of APU intake – may have to shutdown APU. (FCOA 7 Oct 03)
- ❖ This procedure should be read from the FM as required!!!!!!

**Note: Operate APU during de-icing only if necessary. If running, ingestion of de-icing fluid causes nasty smells in cabin. Ingestion of snow, etc or de-icing/anti-icing fluid can damage the APU.**

**Taxying Out**

(A[1] 2813 Apr 06 / FCom1 SP-16-7 Mar 07)

- ❖ If A/C exposed for long periods, thoroughly exercise controls after de-icing completed. (FCOA 7 Sep 00)
- ❖ Exercise nose wheel steering in both directions to get warm hyd fluid through steering cylinders to prevent steering lag.
- ❖ Taxi very slowly (4kts may be too much) & keep greater separation distance.
- ❖ Avoid large tiller inputs when taxiway is slick & in strong x-winds.
- ❖ Use of differential thrust/braking may be more effective than steering on very slick surfaces.
- ❖ Taxi with flaps UP in slush conditions or if PPN with temp below freezing. ('After Start' checks are not complete). Select flaps close to holding point. Cannot do control checks until Flaps selected. DO NOT action BEFORE T/O checks until flaps & controls checked. (This is to protect newly exposed surfaces not protected during de-icing e.g. the LE of the wing covered by the SLATS). (A[1] 2813 Apr 06)
- ❖ Note: taxi without flaps is a SESMA event, but an ASR not required. (A[1] 2813 Apr 06)
- ❖ **Monitor flap position carefully - if they stop, immediately place selector in same position as indicated, return to ramp.**
- ❖ Update the HOT if WXR conditions change.
- ❖ Visually inspect wing prior to T/O, especially if HOT about to expire or exceeded. (A[1] 2814 Dec 05)

**Engine Run Up During Prolonged Grd Ops**

(FCom1 SP-16-10 Mar 08)

During taxi, in or out, in icing conditions and when OAT  $\leq 3^{\circ}\text{C}$ : **Momentary run up to min of 50% N1:-**

- \* G-STBA—TBF, G-YMMA—MMU ( $-300^{\circ}\text{C}$  / RR Engs) - run up at intervals not greater than 60 mins
- \* GE Engs - run up at intervals not greater than 15 mins

On all T/Os: do static run to 50% N1 and stable eng operation before T/O roll, when OAT  $\leq 3^{\circ}\text{C}$

On a slippery RWY, may not be able to stop a slide during a run up, in which case continue T/O – danger of hitting a dry patch with brakes on & damaging tyres. (S Wydra)

**RR Engine - Taxi with Freezing Fog (Core Ice Removal)**

(FCom1 CS3-3475 Sep 06)

- ❖ With freezing fog (visibility  $<300\text{ m}$ ) must either T/O or do Core Ice removal within 'total taxi time' of 45 mins.
- ❖ This procedure does not apply to ops in other types of freezing ppn, since larger ice particles do not cause core icing.
- ❖ If T/O anticipated within 45 mins of eng start, core ice removal not required.
- ❖ During taxi, in or out, when **Freezing Fog** ( $<300\text{m}$ ) is **reported: Momentary run up engines as follows:-**
  - \* When OAT between  $0^{\circ}$  &  $-6^{\circ}\text{C}$ , use 50% N1 for 60 secs every 45mins
  - \* When OAT between  $-7^{\circ}$  &  $-13^{\circ}\text{C}$ , use 59% N1 for 60 secs every 45mins, (N.B. T/O Config warning at 60%)
  - \* When OAT  $< -13^{\circ}\text{C}$ , core ice cannot be shed. Manual de-icing required, or T/O within 45 mins.
- ❖ Taxi in time from previous sector, if it was in freezing fog, to be considered, unless the crew accomplished the Core Procedure within 5 mins of shutdown, or the engine was de-iced and visually inspected by engineering.
- ❖ T/O is permitted within 60 min total taxi time without core ice removal, but must be noted in Tech Log. (Boroscope within 10 flts). After 60 mins with no core ice removal, T/O not permitted.
- ❖ On T/O: do static run to 50% and stable eng operation before T/O roll.
- ❖ A stopped engine stops the 'clock'. Core ice accumulation only occurs when engs running.
- ❖ **Cautions: Jet blast to 900ft (300m); ingestion of snow/ice into eng; slippery taxiways; airport noise restrictions (advise ATC).**

**T/O - Contaminated (PPN Covered) RWY.**

(FCom1 SP-16-8 Mar 06)

- ❖ Use normal procedures & during initial T/O roll. Limit rudder input to half full travel – this allows for any lag in the effect of nosewheel steering or aerodynamic controls.
- ❖ RTO as normal, rudder effective to 50kts. Do not modulate brakes if using manual braking.
- ❖ Eng A/Ice ON for T/O (except in standing water with TAT  $> 10^{\circ}\text{C}$ ).
- ❖ Do not use Wing Anti-ice for T/O.
- ❖ Max depth Wet Snow/Slush/Standing water = 13 mm ( $\frac{1}{2}''$ ). Max depth Dry Snow = 60 mm (2.3''). Personal inspection advised.
- ❖ Max X-Wind 15kt, No TWC.

**Observe**

(PerfM. 5.1.5 Feb 97)

- All stopping devices must be serviceable, (i.e. Brakes/Anti-Skid/Spoilers/Reversers OK).
- Reduced Thrust T/O not permitted if RWY contaminated.
- Tail Wind T/O not permitted.
- Fuel tankering not permitted.
- Must consider nature of over-run, WXR changes since last report, & potential consequences of overrun.
- Use max RWY dist available.
- Visual guidance for T/O – RWY edge lights or markings and/or C/L lights, or markings.
- Min cleared RWY width –150ft (45m), symmetrical with the C/L.
- Cat 2/3 Pub RWY width must not be reduced by snow banks. Max snow bank at RWY edge not  $>2.5\text{ft}$ .
- If OAT  $> -5$ , treat snow as slush. Snow + slush = slush.

## Wing Anti-Icing

(FCom1 SP-16-12 Jan 09; TM[FC2] 03-20-02 Apr 03)

- ❖ Do not use for T/O.
- ❖ **DO NOT operate Wing A/Icing when TAT >10°C, ( **ANTI-ICE ON** advisory msg).**
- ❖ Consider these as de-icers (Auto) OR anti-icers (Man).
- ❖ Performance penalty?
- ❖ WAI uses bleed air to 3 mid wing leading edge slats on each wing. (LE not de-iced, only the slats).
- ❖ WAI Inhibits:–
  - \* Inhibited on the ground.
  - \* Inhibited for 5 mins after T/O if TAT  $\geq 10^{\circ}\text{C}$  (manual and automatic).
  - \* Inhibited, independent of TAT, for up to 10 mins after T/O and with T/O thrust reference annunciated. Inhibit is removed when climb thrust is selected. Manual WAI operation is not affected by this inhibit.
- ❖ If a bleed source is lost and bleed duct isolation has not occurred, the isolation valves automatically open to maintain anti-icing to both wings.
- ❖ A/C capable of safe flt and ldg in icing conditions in the event of 'in flt' failure of WAI system.

## Engine Anti-Ice

(FCom1 SP-16-7 Mar 05)

- ❖ Set EAI to ON after both engs started, if in icing conditions, or if expected immediately after T/O.
- ❖ **DO NOT operate EAI if TAT >10°C, ( **ANTI-ICE ON** advisory msg).**
- ❖ **Manual Anti-Icing** (Switch ldg light on at night), (TAT on EICAS / SAT on Prog page 2).
  - \* CLIMB/CRUISE – Select EAI On, prior to penetration of visible moisture with TAT  $\leq 10^{\circ}\text{C}$ . Not required if SAT  $< -40^{\circ}\text{C}$ .
  - \* DESCENT – Select EAI On, if visible moisture and TAT  $\leq 10^{\circ}\text{C}$ , irrespective of SAT.

## Fuel Freezing

(FCom1 NP-50-9 Mar 03; TM[FC2] 03-20-01 Apr 03)

- ❖ Min in flight =  $3^{\circ}\text{C}$  above Fuel freeze point, ( **FUEL TEMP LOW** advisory msg).
- ❖ Fuel temp will trend towards (TAT  $-3^{\circ}\text{C}$ ), at approx  $3^{\circ}/\text{hr}$ .
- ❖ Increasing Mach by 0.01 raises TAT by approx  $0.5^{\circ}$  to  $0.7^{\circ}\text{C}$ , but has no immediate effect on the actual fuel temp in tank.
- ❖ TAT  $\approx$  SAT +  $30^{\circ}$  @ M.84. (TAT on EICAS / SAT on Prog page 2).
- ❖ Critical temp for  $-40^{\circ}\text{C}$  fuel is  $-37^{\circ}\text{C}$  TAT, or  $-67^{\circ}\text{C}$  SAT (or temp on WXR chart).
- ❖ Critical temp for  $-42^{\circ}\text{C}$  fuel is  $-39^{\circ}\text{C}$  TAT, or  $-69^{\circ}\text{C}$  SAT (or temp on WXR chart).
- ❖ Critical temp for  $-47^{\circ}\text{C}$  fuel is  $-44^{\circ}\text{C}$  TAT, or  $-74^{\circ}\text{C}$  SAT (or temp on WXR chart).
- ❖ FMC default temp is  $-40^{\circ}$ .
- ❖ On a standard day F370/ 0.84M: TAS = 482kts. For every 1 kt below normal TAS =  $1^{\circ}\text{C}$  below STD.

## Fan Blade Icing in Flt

(FCom1 SP-16-9 Mar 06)

**GE eng:** in mod/severe icing for prolonged periods with N1  $< 70\%$ , or when fan icing is suspected due to high vibration, clear ice, one eng at a time, by reduce thrust to idle, then increase to max of 70% N1 for 15 sec every 15 mins.

**RR eng:** when fan icing is suspected due to high vibration, clear ice, one eng at a time, by quickly reducing thrust to idle for 5 secs, then restore thrust. If persists, increase to 90% N1 momentarily.

Problem is generally apparent in descent & at low alt,  $< 15000\text{ft}$  @ 270kts.

## TAT Probe Icing Symptoms

One or more of the following are symptoms of TAT Probe icing:

- ❖ The auto throttle disconnects and the reference / target N1/EPR and reference N1/EPR displays blank
- ❖ The thrust levers are not aligned with the engine N1/EPR displays
- ❖ The eng N1/EPR displays are not aligned with the thrust levers aligned
- ❖ A decrease or increase in the reference / target N1/EPR displays at a constant altitude and speed
- ❖ The engines are unable to achieve the maximum continuous or the maximum climb rating with thrust levers fully forward
- ❖ The TAT display remains constant and near  $0^{\circ}\text{C}$  during climb, cruise or descent

## Descent Point

(FCom1 SP-16-8 Mar 06)

- ❖ Start descent early by 1nm/1000ft that EAI expected to be used,
- ❖ Enter the expected icing level in FMC (Descent Forecast page).

## Low Temp Altimeter Errors

(A[1] 8.1.1.8.3 Jun 08 / IFTM[FC2] 3-4-129)

- ❖ Alt over reads by approx 4% of height /  $10^{\circ}\text{C}$  drop below ISA,
- ❖ or add 4ft per 1000ft to the published altitude for each  $^{\circ}\text{C}$  below STD.
- ❖ Canadian AIP suggests in cold WXR operations use 1000ft above MEA.  
(ILS check heights may be out; e.g. ISA  $\pm 20^{\circ}\text{C}$  @ 1500ft gives error of  $\pm 120\text{ft}$ , – it works in reverse for high temps).
- ❖ See table in Limitations section.



Definitions

<b>Wet Runway:</b>	has up to 3mm of water on the sfc & friction coefficient approx. half that of a dry RWY but with good braking action. No significant areas of standing water. <i>(PerfM. 3.3.6 Dec 99)</i>																			
<b>Contaminated RWY:</b>	A RWY with more than 25% of the sfc area covered by more than 3mm of water or by snow or slush with a water equivalent depth of more than 3mm. Performance figures take into account the use of reverse thrust. Suggesting extra drag/power loss due ingestion/reduced braking from aquaplaning/directional control problems and possible structural damage. <i>(FCIB #23 &amp; 25 Jun 03)</i>																			
<b>Degraded Braking Action:</b>	A RWY covered with compacted snow/ice or a RWY reported as ‘slippery when wet’. <i>(FCIB #23 &amp; 25 Jun 03)</i>																			
<b>Slippery RWY:</b>	defined as having a uniform theoretical braking coefficient of 0.05 Mu. One on which it would be impossible to walk!! <i>(PerfM. 5.1.8 Feb 97)</i> <ul style="list-style-type: none"><li>• Single Engine Landings are NOT ALLOWED. <i>(PerfM. 4.1.5 Feb 97)</i></li><li>• 30 Flap Landing Distances are printed on every page <i>(PerfM.)</i></li><li>• Landing is not recommended when slippery / icy. <i>(FCIB #23 &amp; 25 Jun 03)</i></li></ul> A slippery RWY will always have B/Action POOR, but a POOR RWY is not necessarily Slippery.																			
<b>Flooded RWY:</b>	must be treated as a Contaminated RWY in Take-Off situation. FCIB must be treated as a Slippery RWY in Landing situation. <i>(PerfM. 4.1.4 Dec 99)</i>																			
<b>Braking Actions:</b>	<i>(PerfM..5-1-2 Dec 99; MATS 9-3-3 May 02)</i> <table><tr><th>Braking Action</th><th>Coeff of Friction</th><th>BA definition</th></tr><tr><td>Good</td><td>0.4 +</td><td></td></tr><tr><td>Medium</td><td>0.35—0.30</td><td>Typically covered in snow</td></tr><tr><td>Medium Poor</td><td>0.29—0.26</td><td>Typically covered in compacted ice</td></tr><tr><td>Poor or unreliable</td><td>0.25 &amp; below.</td><td></td></tr><tr><td>Slippery RWY</td><td></td><td>Typical cover of wet ice</td></tr></table> <p>RWY condition code of 91. These figures are good for all types of friction machine.</p>		Braking Action	Coeff of Friction	BA definition	Good	0.4 +		Medium	0.35—0.30	Typically covered in snow	Medium Poor	0.29—0.26	Typically covered in compacted ice	Poor or unreliable	0.25 & below.		Slippery RWY		Typical cover of wet ice
Braking Action	Coeff of Friction	BA definition																		
Good	0.4 +																			
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Medium Poor	0.29—0.26	Typically covered in compacted ice																		
Poor or unreliable	0.25 & below.																			
Slippery RWY		Typical cover of wet ice																		



## Other Weather Effects

### Windshear

(QRH MAN-1-12 May 07)

#### Indications of Windshear:

- ❖ Activation of GPWS windshear warning:  
(Siren + “WINDSHEAR” x3, Time Critical Warning on PFDs, Master Warning Lights)
- ❖ or unacceptable flight path deviations:–
  - \* Below 1000ft agl, uncontrollable changes in excess of:–
    - 15kts IAS
    - 500 fpm
    - 5 degrees pitch
    - 1 dot G/S displacement
    - Unusual thrust lever position for some time.

Crew actions are divided into three areas: Avoidance, Precautions and Recovery.

#### Avoidance:

Using all available resources delay departure or approach i.e. WXR, Pilot reports, etc.

Severe windshear defined as giving airspeed changes of 15kts or more.

#### Precautions:

(FCOM1 SP-16-20 Jun 09)

(Perf M. 3-2-6 Jun 00)

- \* Do not reduce thrust
- \* Use longest runway
- \* Flap 15 provides best compromise for T/O performance, (check obstacle/climb gradient)
- \* Use a Precision Approach aid for better glide path monitoring
- \* Stabilized approach by 1000R at latest
- \* Use the FPV, and PLI if required
- \* Airspeed Trend Vector
- \* Wind and Ground Speed read outs on ND
- \* WXR selected
- \* If A/T disengaged add wind correction, max 20kts.

#### Recovery:

- \* Before V1 - RTO, (provided sufficient runway is available).
- \* Above V1 - Call “Windshear Go Around”.  
Immediately carry out Windshear Go Around Manoeuvre.

#### GPWS Windshear Warnings:

Detection begins at rotation, with excessive W/Shear at the current a/c position detected by GPWS. These warnings are enabled below 1500R. With a W/Shear warning fly the Windshear Go Around.

#### Predictive Windshear System Warnings:

PWS alerts are given prior to entering windshear, using the weather radar (some level of moisture or particulate matter must be present). The weather radar automatically begins scanning for windshear when T/O power is set, or in flight below 2300R, although Alerts are only given below 1200R. Selecting the weather radar enables alerts to be given prior to takeoff on PWS equipped a/c, however, 12 seconds must elapse after the weather radar starts scanning before these alerts are available.

During takeoff and landing, new windshear caution alerts are inhibited between 80kts and 400R, and new warning alerts between 100kts and 50R. Any existing cautions or alerts remain.

#### Windshear Cautions:

- ❖ “MONITOR RADAR DISPLAY” active on take-off and approach.

#### Windshear Alerts:

- ❖ “WINDSHEAR AHEAD” active on take-off only
- ❖ “GO AROUND, WINDSHEAR AHEAD” active on approach only

#### Actions:

Before V1:	Any caution or alert	RTO
After V1:	“MONITOR RADAR DISPLAY”	Manoeuvre to avoid
	“WINDSHEAR AHEAD”	Windshear Go Around
Approach:	“MONITOR RADAR DISPLAY”	Manoeuvre to avoid
	“GO AROUND, WINDSHEAR AHEAD”	Windshear Go Around

(R Izon)

### **Windshear Encounter During Takeoff – On Runway**

If windshear encountered below V<sub>1</sub>, providing sufficient runway available, reject takeoff.

If windshear encountered near the normal rotation speed, but with insufficient runway to either stop or accelerate back to V<sub>r</sub>, apply FULL power and fly normal rotation at least 600 metres before the end of the runway, even if airspeed is low. High nose up attitudes may be required to lift off in the remaining runway.

### **Automatic Flight Windshear Recovery**

The AFDS provides windshear recovery guidance by means of the normal Go Around pitch and roll modes. Until a rate of climb is achieved, the AFDS pitches up to 15 degrees or slightly below the pitch limit, whichever is lower, thereafter the AFDS transitions from pitch to airspeed control.

If the A/P is not engaged when Go Around is initiated, then F/D commands should be followed.

Performance capability of the AFDS may be exceeded in severe windshear, in which case the HP should be prepared to disconnect the A/P and A/T.

### **“Windshear Go Around” Call**

This call indicates to the other crew that a positive rate of climb will be maintained at the expense of airspeed, even to the point of stickshake.

### **Severe Sand & Dust Storms**

(FCO 2564 [Old])

Operate normally. Additionally, on the ground, to minimise sand / dust ingestion under severe conditions, - CONDITIONS PERMITTING:–

- \* Avoid ingestion of jet efflux from other engines.
- \* Avoid static high power operation with sand and dust on runways and adjacent areas.
- \* Use rolling takeoff thrust setting procedures where possible.
- \* Use reverse thrust judiciously, particularly at low ground speeds and when there is an accumulation of sand and dust on runways and adjacent areas.
- \* Shut down engines as soon as practical.

### **Trans-Atlantic Weather Avoidance**

(Nav Canada AIC 35/05 Dec 05)

- ❖ Try for clearance using phrase “WEATHER DEVIATION REQUIRED” to indicate the desired priority. When necessary, use “PAN PAN” (preferably spoken three times). Advise the extent of the deviation expected.
- ❖ Inform ATC when weather deviation is no longer required
- ❖ Actions to be taken if a revised ATC clearance cannot be obtained:–  
Note — The provisions of this section apply to situations where the Captain needs to exercise his authority under the provisions of Annex 2, 2.3. 1.
- ❖ If deviation from track required to avoid adverse met conditions and prior clearance cannot be obtained, an ATC clearance shall be obtained ASAP. Until an ATC clearance is received the pilot shall take the following actions:
  - \* if possible, deviate away from an organized track or route system;
  - \* establish communications with nearby aircraft by broadcasting, at suitable intervals: Flt No, flight level, position, the track code and intentions, on the frequency in use and on 121.5 (and/or 123.45);
  - \* watch for conflicting traffic both visually and by reference to ACAS;
  - \* the pilot is expected to adjust the path of the aircraft, as necessary to avoid conflicting traffic.
  - \* turn on all aircraft exterior lights;
  - \* for deviations of less than 10 nm remain at a level assigned by ATC;
  - \* for deviations greater than 10 nm, when the aircraft is approx 10 nm from track, initiate a level change in accordance with the table below:

Routing	Deviation > 10nm	Level Change
East	Left Right	Descend 300ft Climb 300ft
West	Left Right	Climb 300ft Descend 300ft

- \* when returning to track, be at its assigned flight level when the aircraft is within approx 10 nm of the centre line; and if contact was not established prior to deviating, continue to attempt to contact ATC to obtain a clearance.
- \* If contact was established, keep ATC advised of intentions and obtain essential traffic information.



## Turbulence

(FCOM1 SP-23-1 Mar 03)

### Severe Turbulence

If encountered or forecast: plan to fly approx. 4000ft below the optimum FMC altitude.

If you can't avoid, operate at the Turbulent Airspeed of:–

(FCOM1 L-10-2 Jun 09)

270 kt < 25,000ft.

280 kt/M0.82 ≥ 25,000ft, whichever is lowest.

Maintain min of Min Man + 15 kts at all altitudes when speed < 0.82M

### Moderate Turbulence

Normal FMC target speeds and cruise altitudes should be used.

Do not allow speed to fall below 0.78M or Vref+100 - takes time and fuel to regain cruise speed.

### Light Turbulence Or Smooth Air

Use optimum FMC cruise levels when you can.

Only climb before step-climb points for tactical reasons.

Watch out if you are asked to fly slowly and beware of the margins.

Min speed = 15kts above amber band when below M0.82.

(FCOM1 NP-60-2 Jun 09)

## Jet streams

Jetstream lines on Met Charts sometimes show a double bar across the wind line. This denotes a point on the line where there is a change of level and/or a change of wind speed. The UK Air Pilot does not quantify these changes but Belgian met office quantifies them as a point on the line where there is a change of level of 3000ft or less and/or a change of wind speed of 20 knots. Also, heavy line delineating where jet axis begins and ends is where a wind speed of 80 knots is forecast. Points of forecast maximum w/v along jet are depicted with arrow shafts.

## Utilising the Radar

(FCOM1 SP-16-17 Jun 09)

777 Radar Beam Width is 3.4° and Beam Height is 3.6°. From this calibration of true zero tilt can be checked. At 10,000ft and zero tilt the beam will strike the ground at a range of 52 nm At 20,000ft it's 104 nm and at 30,000ft it's 156 nm.

- ❖ Avoid magenta (WX+T) & red areas by 20 nm above FL 230 & 5nm below FL 230.
- ❖ Avoid single magenta areas of turbulence (no ppn) by 5nm.
- ❖ Avoid cell tops by 5000ft vertically.
- ❖ Avoid over flying cells at or above 25000ft.
- ❖ Avoid flying under a thunderstorm due microburst/hail etc.

### Turbulence mode

(FCOM1 SP-16-18 Jun 09)

Turbulence detection only effective to 40 nm and at this range the beam subtends 15,300ft. Or to put it another way - with zero tilt the bottom of the beam will strike the ground at 40 nm when you are a height of 7,650ft.

### TILT

At range of 40 nm, each 1° tilt of the beam up/down moves it by 4,250ft up/down.

At range of 40 nm, setting the beam at 2° UP covers you from just below your altitude to 16,000ft above your altitude.

**NOTES for USA**

(AIM 7-1-5)

In the USA be aware that Severe Weather Forecast Alerts (AWW), Convective Sigmets (WST) Outlooks, Forecasts and Severe Weather Watches are produced by the Aviation Weather Centre at Kansas City, Missouri. Convective Outlooks are appended to US weather reports in the form of an AC note. AC notes are also used in preparing the Severe Weather Outlook Chart and thus are associated with severe thunderstorms.

In flight - consult flight watch (see High Level charts for freqs) for up to date radar weather info. They can provide comprehensive info on likely thunderstorms and forecast times of these storms over your destination. (G Leask)

**RADAR SUMMARY CHARTS**

are presented in the USA with pre-flight weather briefings. Areas of precipitation include indications of VIP levels. The Video Integrator and Processor contours radar reflectivity (in dBZ) into six VIP levels:

VIP 1	(Level 1, 18-30 dBZ) -	Light precipitation.
VIP 2	(Level 2, 30-38 dBZ) -	Light to moderate rain.
VIP 3	(Level 3, 38-44 dBZ) -	Moderate to heavy rain.
VIP 4	(Level 4, 44-50 dBZ) -	Heavy rain.
VIP 5	(Level 5, 50-57 dBZ) -	Very heavy rain; hail possible.
VIP 6	(Level 6, >57 dBZ) -	Very heavy rain and hail; large hail possible.

Echo intensities assigned as VIP level 3 or higher should be considered extremely hazardous. A level 3 storm is classified as strong and will depict red on the radar screen.

**Convective Sigmets (WST) are issued for:–**

- Severe Thunderstorm
- Embedded thunderstorms
- A Line of thunderstorms
- Thunderstorms greater than or equal to VIP level 4

**Criteria for Severe Thunderstorm:–**

1. Surface winds  $\geq 50$  knots
2. Hail at surface  $\geq \frac{3}{4}$  inch in diameter
3. Tornadoes affecting 40% or more of an area at least 3,000 sq miles.

**Speed of those golf balls**

The speed (mph) of hail stone is =  $54 \sqrt{\text{Hail diameter (in)}}$

e.g. a 4 inch hail stone falls at 108mph. Ouch!

(N.B.)

**NOTES for Canada**

(CCAA Web site)

JB1 appears to be only in use at some military fields. Canada now uses RWY Friction Index (CRFI).

**Braking Action Comparisons**

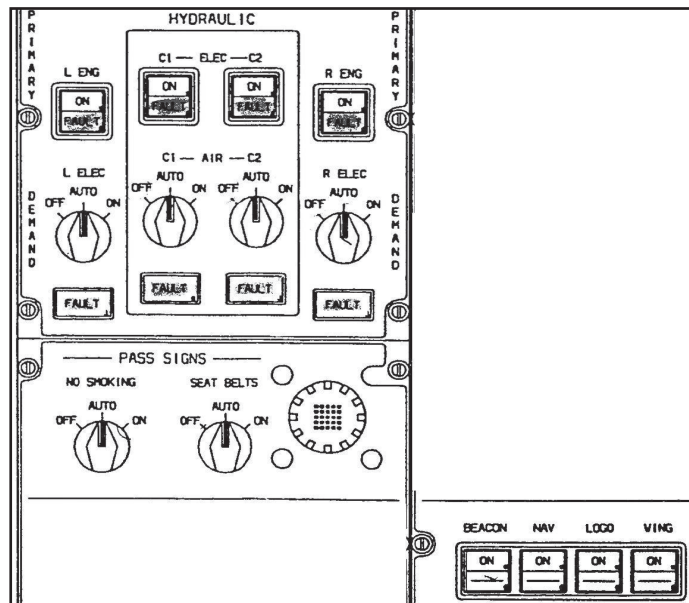
R/W Braking Action Comparisons										
RSC	ICAO		Japanese	French	Canada	Military	USA		MOTNE	METAR
	Co-eff	B Action	B Action	B Action	JB1	RCR	Mil BA	Civil BA	Snowtam	Code
No snow/ice	N/A	N/A	N/A	N/A	> 0.60	> 18.5	Good	> 50	N/A	N/A
V Light snow patches	0.40 – 0.47	Good			0.49 – 0.55	12.8 – 15	Fair	40 – 47	5	95
Packed Snow or Sanded Ice/snow	0.36 – 0.39	Medium / Good			0.47 – 0.48	12.5–11.5		36–39	4	94
	0.30– 0.35	Medium			0.40 – 0.46	9.6 – 11.2	Poor	30–35	3	93
Compacted Snow (<–15 °C)	0.26 – 0.29	Poor / Medium		Low to Medium	0.34 – 0.39	8.3 – 9.3		26–29	2	92
Snow covered/ Compacted Snow	< 0.25	Poor	Poor	Low	< 0.33	< 8		< 25	1	91
Ice	< 0.20		Very Poor		< 0.26	< 6.4	Nil	< 20		
Slush/Loose snow	Not Measured / Unreliable							N/A	9	99

# 9 • Procedures

## # Push/Start Procedure

(FCom1 NP-30-29 May 07)

Have Door synoptic on one side.



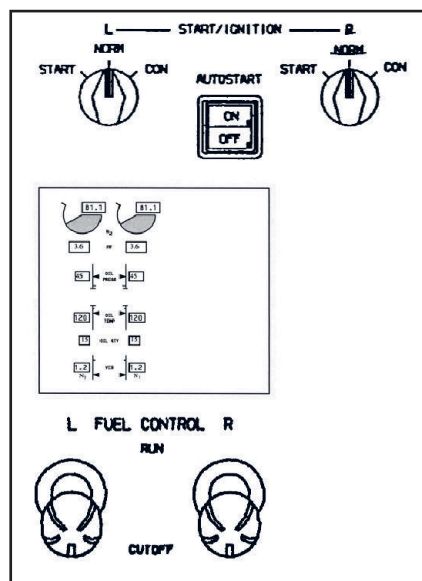
PAX Signs  
HYD'S R Dmd P  
C1 Prim P  
C2 Prim P  
L, C1, C2 Dmd P's  
BCN  
Transponder  
RECALL –  
checking, (normally only ENG SHUTDOWN & TCAS OFF)

Auto or ON  
AUTO (must be on 1st)  
ON  
ON  
AUTO  
ON  
XPNDR  
cancel the items after  
checking, (normally only ENG SHUTDOWN & TCAS OFF)

Aide memoir...  
'PAX HYD the BCN I RECALL'

## # Starting Procedure

(FCom1 NP-30-30 May 07)



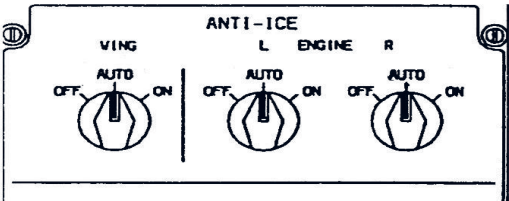
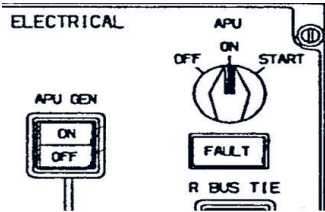
Sec Eng display  
Start/Ign switch  
Fuel Cntrl  
Monitor Oil press rise

START  
RUN

Nuisance status msg OIL PRESS SENSORS L/R may be displayed

# After Start Procedure

(FCom1 NP-30-31 Jun 09)



APU	OFF (unless MEL). Check GEN OFF light is not on.
Eng A/Ice selectors	As required.
Call	“After Start Checklist”
Grnd Crew clearance visually received:	(Do not select flaps until Grnd clearance received)
“Select Flaps”	(except icing conditions perhaps)
Flaps	“Flap X selected”
RECALL	TCAS OFF only msg normally – don’t cancel this time.
Before T/O checklist	Display

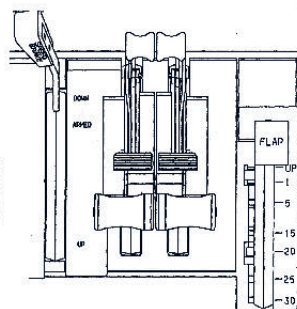
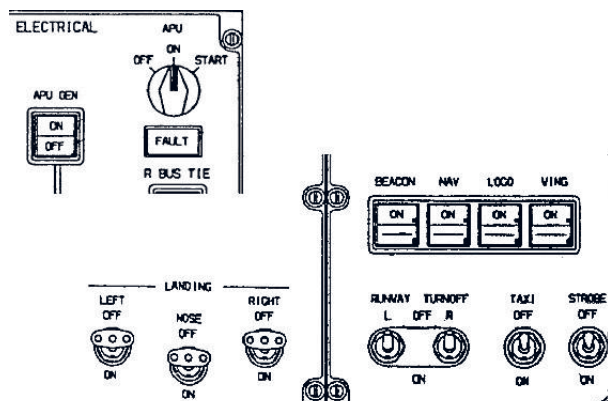
# Before T/O Procedure

(FCom1 NP-40-6 May 07)

Before T/O checklist	Displayed
Flt Controls	Check (Slowly)
Transponder	Set (code & TA/RA)
Trims	Set
“Before T/O checklist”	

## # After Ldg Procedure

(FCom1 NP-80-1 Jan 09)



WX Radar

WX Radar

A/Brake

TXPDR

SPEEDBRAKE LEVER

STROBE LIGHTS

FLAPS

WEATHER RADAR

LANDING LIGHTS

A/BRAKE SELECTOR

TRANSPONDER

“After Landing Checklist”

DOWN (HP)

OFF

UP

OFF

As REQUIRED

OFF

TXPDR (TCAS OFF EICAS message).

Consider, carefully, shutting down one engine. Observe cool down times.

RR 1 min. GE 3 mins. Taxi power only.

APU SELECTOR

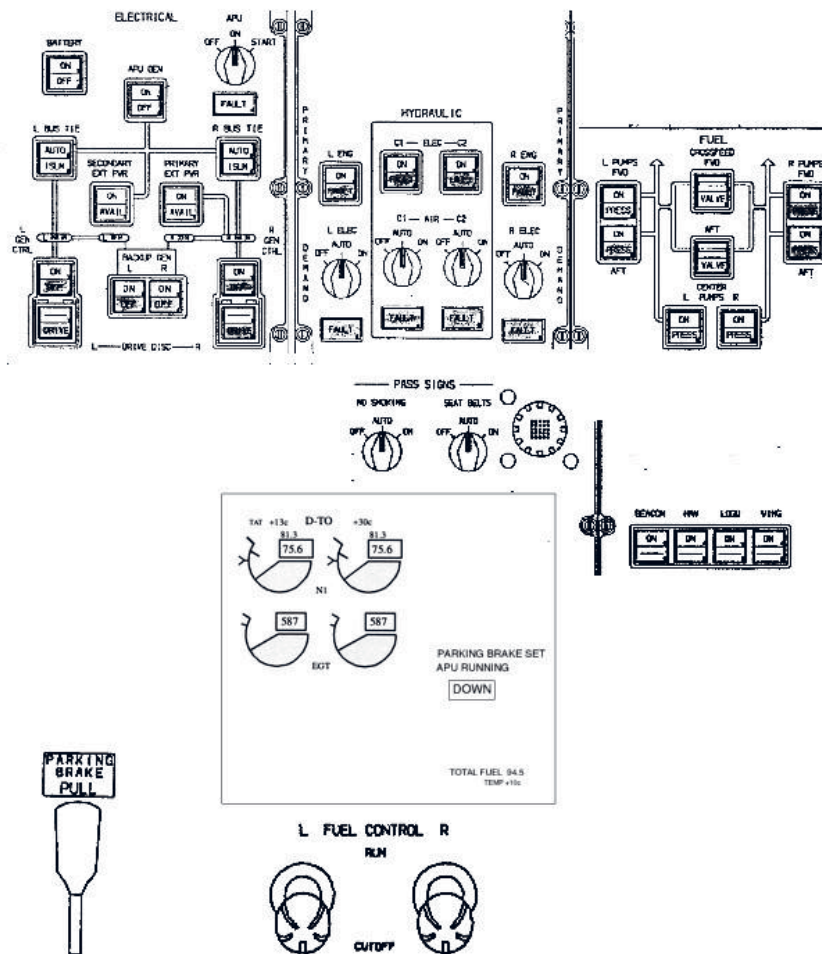
START (2 mins before shutdown).

Approaching stand

“Cabin Crew, Doors to Manual and Crosscheck”.

## # Shut Down Procedure

(FCom1 NP-80-5 Jan 09)



PARKING BRAKE	SET
ELECTRICAL POWER	Check APU RUNNING msg.
	Primary External Pwr switch - Push (If AVAIL light illuminated).
	Secondary External Power switch - Push (If AVAIL light illuminated).
FUEL CONTROL Switches	CUTOFF
SEAT BELT SELECTOR	OFF (must be left on for towing)
HYDRAULIC PANEL	(must be left on for towing)
	C1 & C2 PRIM pumps OFF
	L, C1 and C2 Dmd Pumps OFF
	R Dmd Pump OFF (must be last off).
FUEL PUMP switches	OFF
BEACON	OFF
FLIGHT DIRECTORs	OFF
TRANSPONDER	2000 STBY (2000 in UK / 1000 all other airports)
STATUS	CHK (Side display - look up present leg faults)
Wait approx 3mins after HYD PRESS SYS L+C+R shown before recording status & alert messages.	

“Shutdown Checklist”

FLIGHT DECK ACCESS OFF/UNLOCKED

# 10 • Recall Checklists

## Required Recall Checklists

### ***u Aborted Engine Start L, R***

(QRH 7.1 Jun 10)

- ❖ Start parameters exceeded
- ❖ EGT rising rapidly approaching limit during manual start, (hot start)
- ❖ No oil pressure indication after EGT rise

(FCom1 NP-30-29 Mar 08)

# FUEL CONTROL switch .....CUT OFF

### ***[] Eng Autostart L, R***

(QRH 7.4 Jun 10)

During ground start:

- ❖ Eng has failed to start.
- ❖ Fuel control switch is in RUN at low engine RPM with the autostart switch off

# FUEL CONTROL switch .....CUT OFF

### ***u Eng Lim/Surge/Stall L, R***

(QRH 7.6 Jun 10)

- ❖ Eng indications abnormal, or approaching limits
- ❖ Abnormal noises (possible airframe vibrations)
- ❖ No response to thrust lever
- ❖ Flames reported in the eng inlets or exhausts

# AUTOTHROTTLE ARM switch ..... OFF

# THRUST LEVER.....RETARD (till within limits or idle)

### ***u Eng SVR Damage/Sep L, R***

(QRH 7.8 Jun 10)

- ❖ Airframe vibrations with abnormal eng indications
- ❖ Engine separation

# AUTOTHROTTLE ARM switch ..... OFF

# THRUST LEVER .....CLOSE

# FUEL CONTROL switch .....CUT OFF

# ENGINE FIRE switch ..... PULL

Land at nearest suitable airport.

### ***[] Fire Eng L, R***

(QRH 8.1 Jun 10)

# AUTOTHROTTLE ARM switch ..... OFF

# THRUST LEVER .....CLOSE

# FUEL CONTROL switch .....CUT OFF

# ENGINE FIRE switch ..... PULL

If FIRE ENG message remains:

# ENGINE FIRE switch .....ROTATE (hold 1 sec)

If after 30 secs FIRE ENG message remains:

# ENGINE FIRE switch ..... ROTATE TO OTHER BTL (hold 1 sec)

u Dual Eng Fail/Stall

(QRH 7.2/3 Jun 10)

- ❖ Eng speed for both engines below idle

# FUEL CONTROL switches (both) .....	CUT OFF, then RUN
# RAM AIR TURBINE switch .....	PUSH (& hold 1 sec)
GE Eng Airspeed set .....	Above 270 kts
RR Eng Airspeed set .....	Above 250 kts

[] Stabiliser

(QRH 9.1 Jun 10)

- ❖ Uncommanded stabiliser motion detected
- ❖ Stabiliser inop.

# STAB CUTOUT SWITCHES (Both) .....	CUTOUT
# DO NOT EXCEED CURRENT AIRSPEED	

[] Cabin Altitude

(QRH 2.1/4 Jun 10)

# O2 MASKS .....	DON
# CREW COMMS .....	ESTABLISH
# CABIN ALTITUDE RATE .....	CHECK
Pause - are we out of control?	
# PAX O2 .....	ON (hold 1 sec)
# DESCENT .....	ACCOMPLISH (No delay)
Level off at MSA or 15,000ft (10,000ft if fuel endurance is not critical), whichever is higher.	
When flying over high terrain, “PASSENGERS AND CREW KEEP MASKS ON (give estimate of oxygen duration)”.	
When conditions permit, “THE DESCENT IS NOW COMPLETE, WILL THE SCCM REPORT TO THE FLIGHT DECK”.	



**GPWS “PULL UP” Warning/Terrain Avoidance #**

(QRH MAN-1-6 Jun 10)

CALL ..... “PULL UP, G/A”  
 A/P & A/T ..... DISCONNECT  
 THRUST LEVERS aggressively ..... MAX THRUST (certified)  
 ATTITUDE ..... LEVEL WINGS: ROTATE 20°NU  
 SPEED BRAKES ..... DOWN  
 If grnd contact a factor – continue rotation to PLI or initial buffet/stick shaker.  
 Use whole hand to sweep the T/Lever AND Spd Brake forward.

**GPWS “Windshear” Warning #**

(QRH MAN-1-11/12 Jun 10)

CALL ..... “WINDSHEAR G/A”  
 In Manual Flt  
 A/P ..... DISCONNECT  
 TOGA ..... PUSH; Verify TOGA annunciated  
 THRUST LEVERS aggressively ..... MAX Certified THRUST  
 A/T ..... DISCONNECT  
 ATTITUDE ..... Level Wings: ROTATE 15°NU: Follow F/D  
 SPEED BRAKES ..... DOWN  
 In Auto Flt  
 TOGA ..... PUSH; Verify TOGA annunciated  
 THRUST LEVERS ..... Verify G/A THRUST  
 SPEED BRAKES ..... DOWN  
 Monitor performance. (AFDS may not cope with severe W/Shear – disconnect A/P & A/T)  
 Use whole hand to sweep the T/Lever AND Spd Brake forward.

**TCAS Resolution Advisory (RA) Warning #**

(QRH MAN-1-8 Jun 10)

A/P & A/T ..... DISENGAGE  
 PITCH ATTITUDE ..... AS REQ  
 THRUST LEVERS ..... AS REQ  
 Attempt visual contact  
 IF STICK SHAKE OCCURS, TAKE STALL RECOVERY ACTION  
 A DESCEND (fly down) RA below 1000 ft AGL should not be followed.

**TCAS ‘Climb’ RA In Landing Config #**

(QRH MAN-1-8 Jun 10)

A/P & A/T ..... DISCONNECT  
 PITCH ATTITUDE ..... AS REQ  
 THRUST LEVERS ..... G/A  
 FLAPS ..... 20  
 GEAR ..... UP  
 Attempt visual contact  
 IF STICK SHAKE OCCURS, TAKE STALL RECOVERY ACTION

**u Airspeed Unreliable #**

(QRH 10.1 Jun 10)

# PITCH ATTITUDE & THRUST ..... CHECK  
 IF NOT NORMAL:  
 # A/P & A/T ..... DISCONNECT  
 # FLIGHT DIRECTORS (both) ..... OFF  
 # PITCH ATTITUDE & THRUST ..... ADJUST

**u Emergency Evacuation**

(QRH Backcover 1 / 2 Mar 09)

**Captain**

Call "PAX evacuation"

# PARKING BRAKE.....	SET
# FUEL CONTROL switches (Both) .....	CUTOFF
# EVACUATION.....	INITIATE
"THIS IS AN EMERGENCY, EVACUATE, EVACUATE" .....	Activate evac alarm
Notify ATC/Ground crew of evacuation	

Reset radio to Comm 1

**F/O**

# OUTFLOW VALVE switches (Both) .....	MAN
# OUTFLOW VALVE MANUAL switches (Both) .....	PUSH & HOLD until outflow valves fully open
# ENGINE FIRE SWITCH (Both) .....	PULL
*****Do not pull ENG FIRE switches before the FUEL CUTOFF switches are in CUTOFF*****	
# (If required) .....	ROTATE & HOLD 1 sec
# APU FIRE switch .....	PULL
# (If required) .....	ROTATE & HOLD 1 sec

- ❖ Try for vis inspection prior to evacuation
- ❖ If Cargo Hold fire/smoke – evac a/c (normally or slides) before holds opened by fire crew
- ❖ Cabin crew can initiate evac for:
  - \* Severe damage to a/c
  - \* Landing on water
  - \* Uncontrollable cabin fire/smoke
  - \* Abnormal A/C attitude

Tech notes:

- ❖ Placing Fuel Control Switches to Cutoff shuts down engines to reduce damage to slides or Pax/crew. The Eng Fire Switches are unlocked and pax doors flt locks are removed.
- ❖ Positioning the out flow valves fully open, depressurises the cabin, ready for doors to be opened.
- ❖ Fire switches (if required) should be turned in opposite directions and held for a min of 1 sec against the stop. Pulling the switch shuts all combustibles off, firing the extinguisher reduces the fire risk.
- ❖ APU - shutting down APU removes electric from the door flt locks.
- ❖ Closing fuel switches in the wrong order may leave the Fuel Spar valve partially open, and potentially feeding the fire. This is subject to a FAA airworthiness directive.

## Other Non Recall & Quick Action Checks

### **u Aborted Engine Start L, R**

(QRH 7.1 Mar 09)

- ❖ Start parameters exceeded
- ❖ EGT rising rapidly approaching limit during manual start, (hot start)
- ❖ No oil pressure indication after EGT rise

(FCOM1 NP-30-29 Mar 08)

# FUEL CONTROL SWITCH .....	CUT OFF
If on grnd	
START / (IGNITION) SELECTOR.....	START
Motor engine for 30 seconds	
START / (IGNITION) SELECTOR.....	NORM

### **u Fire Engine Tailpipe L, R**

(QRH 8.3/4 Jun 10)

- ❖ Tailpipe fire reported with no eng fire warning

# FUEL CONTROL switch .....	CUT OFF
Advise cabin	
If bleed air available:	
START / (IGNITION) SELECTOR.....	START
Advise Tower	
Motor engine till tailpipe fire extinguished	
START / (IGNITION) SELECTOR.....	NORM

### **[ ] Fire APU**

(QRH 8.1 Mar 08)

# APU FIRE SWITCH .....	PULL & ROTATE (hold for 1 sec)
-------------------------	--------------------------------

- ❖ Inform Cabin crew immediately.

(A[1] 8.11.14.4 Jun 08)

### **u Smoke, Fire or Fumes**

(QRH 8.6 Jun 09)

# O2 MASKS & GOGGLES (if req) .....	ON
# CREW COMMS (if req) .....	ESTABLISH
Isolate source - remove power.	
If smoke persists land at nearest suitable	

### **[ ] Fire Wheel Well**

(QRH 8.15 May 09)

LDG GEAR (< placard speed (270/.82M)) .....	DOWN
Land at nearest suitable airport.	

### **[ ] Fire Cargo Aft**

(QRH 8.11 May 09)

AFT CARGO FIRE ARM SWITCH .....	ARMED
CARGO FIRE DISCHARGE SWITCH .....	PUSH (1 sec)
LDG ALTITUDE SELECTOR .....	PULL, SET 8000
Evacuate lower crew rest compartment & close hatches.	
Land at nearest suitable airport.	
Note: if on grnd ensure all personnel clear of the door area if open & all pax/crew evacuated.	

### **[ ] Fire Cargo Fwd**

(QRH 8.13 May 09)

FWD CARGO FIRE ARM SWITCH .....	ARMED
CARGO FIRE DISCHARGE SWITCH .....	PUSH (1 sec)
LDG ALTITUDE SELECTOR .....	PULL, SET 8000
Land at nearest suitable airport.	
Equipment cooling normal mode inop.	
Note: if on grnd ensure all personnel clear of the door area if open & all pax/crew evacuated.	

Door Aft/Fwd Cargo

(QRH 1.1/2 & 4 May 09)

For Fwd Cargo msg (all types) & AFT CARGO msg [G-VIIB — G-YMMU & G-RAES]

LDG ALT Selector .....	PULL, Set 8000
ALTITUDE.....	Descend / Maintain highest of 8000 or MSA
Depressurise a/c	

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## General

### Operations (General)

- ❖ Consider using the **uEMERGENCY LANDING** checklist. (QRH 0.3 Jun 09)
- ❖ Overweight ldg – use the **uOVERWEIGHT LANDING** checklist. (G/A may be F5). (QRH 0.7 Jun 09)
- ❖ If QRH consulted for ldg dist, then both pilots to check & compare results. (+ 50% for operational deviations)
- ❖ In emergency, inform ATC of any dangerous goods on board & position on a/c. See NOTOC. (FCIB #43/A[1] 8.3.1 Jun 08)
- ❖ **Fire service 121.6** for all UK A/F's with fire Cat 5 or higher. C/S 'Fire Chief'. (Fire Service Man)
- ❖ Any fire – Mayday call. Use NITS format.
- Any contained eng fail – PAN call. (A[1] 8.11.3 Jun 08)  
(PAN required if descent clearance needed).
- ❖ When giving NITS briefing say "This is your NITS briefing." KISS - don't elaborate.  
Tell the SCCM to expect NORMAL or EMERGENCY ldg. (A[2] 4.2.3 Jun 09)  
Give Cabin Manager time to brief rest of crew. (G Hallatt / R Izon)
- ❖ After emergency over, explicitly tell cabin crew it is over so that they can stand down. (A[2] 4.1.2 Jun 09)
- ❖ Switch off moving map if diverting.
- ❖ Hand flown approaches – decision to G/A should be made before "Decide" call. (A[1] 8.1.3.2.9 Jun 08)
- ❖ C/B Resets: not recommended unless tripped C/B has adverse effect on safety. (FCO 2560 [Old])
  - \* Do not reset fuel pumps and refuel C/B's, or domestic service C/B's in flight.
  - \* Only 1 reset allowed. (Allow 2 mins cooling time).
  - \* Tech log entry for any tripped or reset C/B.
  - \* On ground - consult engineering before a reset.
- ❖ SAR – 123.1 Civil scene of search freq. (D Rostron)
- ❖ After emergency on R/W (T/O or Ldg) Capt to make an PA as soon as practicable if evac not required, "Pax & crew remain seated & await further instructions". (A[1] 8.11.10 Jan 10)

### IRR (General)

- ❖ Check license medical up to date & signed! Take TM & FM to SIM.
- ❖ Check NuBrief for correct A/C type & U/S items. Check & read all notes on let down plates.
- ❖ LPC requires manual ILS and G/A. A/Pilot used for briefing & hand over and most everything else.
- ❖ All approach aids need to be identified, aurally or visually, before use.
- ❖ F/D needs to be programmed and used correctly.
- ❖ Max bank 25° without F/D.
- ❖ Bug required speed, and fly to it.
- ❖ Don't forget the altimeter X-check at the FAF. This is the only check of QNH.
- ❖ Use paper checklist to brief for the arrival whilst on grnd.
- ❖ Get WXR prior to descent briefing, & get RVR check prior to 1000 point, (1500R suggested).
- ❖ Descent Brief items: call for latest WXR (RVR is the CAA requirement), check plates for LDA, approach lights, fast turnoffs.
- ❖ Agree on when to start stopwatches for timing NPA.
- ❖ NPA assessable to DH - don't take over early.
- ❖ Tolerance at the FAF is now –70ft. Can now pre-empt BCN passage to get A/C going down.
- ❖ A RTO that is taken to a full conclusion is required. i.e. Fire Eng checklist / clear RWY / Brake Temps etc.
- ❖ If NN appears after Descent check complete - go back and redo checklist. Sweep up items introduced by QRH.

### DODAR

Diagnose,  
Options,  
Decision,  
Assign tasks,  
Review.

## Proficiency Check (OPC)

### EFATO

(QRH MAN-21-1 May 07)

EFATO	
HP	NHP
FAILURE Rotate 2°/sec to 10° Maintain heading with smooth rudder application <b>First indication after airborne will be Roll</b> “Gear Up” At 200R, rudder trimmed: “AutoPilot” At 400R, roll mode annun: Call for recall actions. Aa - Retract flaps on schedule Vref+80 Check power - CON Call for QRH e.g. “FIRE ENG CHECKLIST” “After T/O checks” Select ENG OUT (5R) at MSA.	“Engine Fail” or “Engine Fire”  “Positive Climb”  NHP restates failure specifically after A/P engaged. (4 options) Completes recall actions  Check power - CON  MSA call.

- ❖ TOGA on grnd:– (TM[FC2] 04-10-18 Apr 03)
  - \* if speed < 50kts, pressing TOGA gives THR REF.
  - \* if speed > 50kts, A/T will not engage. A/T inhibited between 50kts to 400R.
  - \* speed > 80kts pressing TOGA disarms LNAV/VNAV.
- ❖ Use a rotation rate slightly lower than normal due to slower acceleration, especially in low vis procedures, as it allows time to counteract yaw and keep a/c straight, wings level. Liftoff may occur at a higher pitch attitude than with 2 engines operating.  
 EFATO – rotate to 10° @ 2°/sec (slower rate) – maintain V2 to max of V2+15.  
 [Normal T/O – rotate to 15° @ 2½°/sec – maintain V2+15 to max of V2+25. (6 divisions on PFD)]
- ❖ V1 & Vr are often the same, so an eng fail happens after normal rotation initiated. Slow the rotation & go for 10° not 15°. Hold 10° & wait for F/D to catch up, then follow F/D, no need to wait for VNAV to engage.  
 F/D knows what speed failure occurs at.
- ❖ Note: Danger of tail scrape at a pitch of 12°, wheels on RWY, gear struts extended.
- ❖ If reduced thrust is used, performance is conservative and it is not necessary to increase thrust for T/O.  
 If max (G/A) thrust required, disconnect A/T and manually set T/Levers (to stops if EEC operating).  
 After flaps up, reselect A/T (push A/T switch). Ensure CON annunciated. (QRH MAN-21-2 May 07)
- ❖ With eng fail on grnd, F/D commands V2 or lift off speed, whichever greater. (TM[FC2] 04-20-11 Apr 03)
- ❖ With eng fail after lift off, F/D commands V2 if below V2, or existing speed at failure up to V2+15.  
 If airspeed > V2+15, F/D commands V2+15. Climb attitude approx 12°.
- ❖ At & below V2+10, bank angle is limited by AFDS (AUTO BANK) to 15°, increasing gradually to 25° at V2+20.  
 Limit bank angle to 15° up to V2+15. At V2+15 with T/O flap, bank angles up to 30° are permitted. (QRH MAN-21-3 May 07)
- ❖ Min height for A/P engagement is 200ft. Ensure rudder is trimmed before engaging A/P.
- ❖ With A/P engaged still need to operate rudder, (TAC provides some rudder input).
- ❖ Correct rudder input is when control wheel is centred. (If left aileron required – more left rudder). More power means more rudder!
- ❖ Note: Rudder trim has two speeds of operation.
- ❖ With VNAV: at Vref30+80 with Flaps up FMC commands climb, & A/T automatically set CON. Confirm on EICAS.
- ❖ Without VNAV: set Vref30+80 (FUp manoeuvre) at Aa. When flaps up, select FLCH. FLCH sets CON. Confirm on EICAS.
- ❖ Remain at Vref30+80 until MSA & then set ENG OUT on CDU ACT CLB page (5R). Speed then changes to approx Vref30+90.  
 Hence, want CLB page selected before T/O.
- ❖ CLEAN – CON – CHECKLIST

### Eng Fail Notes

- Put enough rudder in to stop swing then hold rudder, adjust rudder when stable and trim.
- Ignore T & Slip indications which are not good – use Boeing method. (T Davis)
- Get A/P in early (200 agl) – pause, think, emergency turn? Don’t rush to identify failure. (Inform ATC of any turns)  
 With A/P in – can make own MCP selections. (G Carfoot)
- NHP to concentrate on the fire drill & not be distracted with R/T etc. Otherwise, may forget 2nd bottle.
- Don’t forget PG Tips, (Pitch, Gear, Turn). Emergency turns, or SID considerations, (in USA may be a specific heading just after T/O – no drift added in USA).
- A/C flies wing down towards the live eng, (ball out to live eng). (G Hallatt)
- A/P does not know position of the ball. F/D assumes balanced flight.
- With TAC off – require approx 12 units rudder trim after T/O and 10 units for climb.
- Easy numbers to remember are 3/6/10/12, (descent/level/derated thrust climb/G/A power).
- Vref + 80 = FUp manoeuvre = Max angle of climb.
- Do not use FLCH until flaps are up.
- If full power required – disengage A/T & push T/lever full forward (EEC operating normally). Re-engage when clean so that thrust transitions to CON. (G Leask)
- TCAS is switched to TA ONLY. Do not have full TCAS protection – prevents CLB commands.
- Any fire – **Mayday** call. Any contained eng fail – **PAN** call. (A[1] 8.11.3 Jun 08)

- Pushing rudder trim reset btn removes man trim, not the TAC trim.
- Policy is to dump to MLW, unless Capt determines a/c at risk, in which case make an immediate overweight landing. This allows time for crew to prepare cabin.  
The Overweight Landing Checklist should be accomplished if possible. *(Horizons Jun 06)*
- Fuel balancing – wait for caution msgs to appear.  
Balancing whilst jettisoning is OK and can save time. *(Horizons Jun 06)*  
Can land with X-feeds open. Balancing not required if on finals.  
Make a positive attempt to check for fuel leaks. *(G Leask / C Mathews)*
- Leave T/Lever at idle for failed eng.
- Allowed 15° swing on base check for EFATO.
- In circuit (SE)                      Flap 5                      76%                      5° NU att.                      5° rudder *(G Hallatt)*  
Approach (SE)                      Flap 20                      62%                      2½–3° NU att.                      3° rudder  
Note: rudder required – pitch required!!!  
Easy numbers to remember are 3/6/10/12, (descent/level/derated thrust climb/G/A power).
- Beware tendency to float on ldg.
- When prompted to 'RECALL' in checklist, confirm with HP before clearing.
- F/D recognises failure by loss of N2. TAC by loss of 10% power.
- VNAV switches to eng out mode with the loss of 15% power. *(A Stewart)*
- In a WAT limited T/O, the Flap Up point can be 14nm down range. May be close to enroute obstacles.
- A swung cone finishes at the FUp point. *(G Hallatt)*
- Do not relight eng unless greater emergency exists. *(A[1] 8.11.13 Jun 08)*
- PFD time critical warning **ENG FAIL** means: eng < commanded thrust & speed between 65kts & V1–6kts. *(TM[FC2] 07-20-25 May 07)*

### Possible Engine Failures

Failures come in 4 flavours:

*(TD)*

- **[ ] FIRE ENG L/R** – EICAS msg. Shut down by recall actions. *[R]*
- **[ ] ENG FAIL L/R** – EICAS msg. Sit on hands. No recall items - use QRH
- uEng SVR Damage/sep – No msg. Shut down by recall actions. *[R]*
- uEng Lim/Surge/Stall – No msg. Recall actions but not shut down. *[R]*
- **[ ] ENG FAIL L/R** msg means engine below idle. Could also mean it's SVR damage. *(TM[FC2] 07-20-27 Dec 09)*
- Note: the severe damage checklist is buried in the unannunciated lists. If this checklist required, the ENG FAIL checklist will pop up first when CHKL btn pressed.
- Always clear MFD & EICAS msgs when checklist complete. Any incomplete NN checklist will pop up first when press CHKL btn again. Also have an amber NN, bottom RHS of MFD as a reminder.
- After an EFATO, may be more than one checklist to do. Often the ENG FAIL checklist has to be completed.

### [ ] Fire Engine L/R Checklist

*(QRH 8.1 Jan 09)*

- ❖ NHP State failure non-specifically. ("Engine Fail")
- ❖ Cancel panic warning
- ❖ Engage A/P, (200 agl)
- ❖ After Gear Up                      "Fire Engine L/R"
- ❖ A/T Arm switch OFF.
- ❖ "L/R Thrust Lever confirm"                      – CLOSE SLOWLY, (Includes reverse)
- ❖ "L/R Cutoff lever confirm"                      – CUT OFF
- ❖ Pull Fire handle
- ❖ Check for **[ ] FIRE ENG L/R** on EICAS, if present – turn handle, ensure bottle is fired, – stopwatch.  
Fire second bottle if required. Ensure 2nd bottles is fired. NHP can use electronic checklist for bottle timer.
- ❖ Fire BELL is inhibited until 400ft aal, (i.e. Boeing thinks this is a good time for checks).
- ❖ MAYDAY (If Fire). Cancel warning.
- ❖ Note that pulling the fire handle will remove the relight pop up info.
- ❖ QRH is completed after flaps up. Review and cancel EICAS msgs, then do AFTER T/O checks.
- ❖ If fire is out, the checklist brought up will be 'ENG FAILURE' – override this, as it is not needed – but gives the option to restart eng, which is not required in this case.
- ❖ A fire warning may persist after the fire is out, even though both fire bottles may have been fired, due to the residual heat in the detector. May take up to 10 minutes to cool.

```
# AUTOTHROTTLE ARM switch ..... OFF
# THRUST LEVER .....CLOSE
# FUEL CONTROL switch .....CUT OFF
# ENGINE FIRE switch ..... PULL

If FIRE ENG message remains:
# ENGINE FIRE switch .....ROTATE (hold 1 sec)

If after 30 secs FIRE ENG message remains:
# ENGINE FIRE switch ..... ROTATE TO OTHER BTL (hold 1 sec).
```



# 777 Engine Failure/Fire after take off

## Notes

A/P @ 200AGL.

Rudder correct when control wheel centred, F/D only correct in balanced flt.

TOGA – R/W track.

LNAV – if no Perf restrictions, maintain SID, or R/W Hdg if no SID.

HDG SEL – Emergency turn/swung cone or R/W hdg in the USA @ 400R.

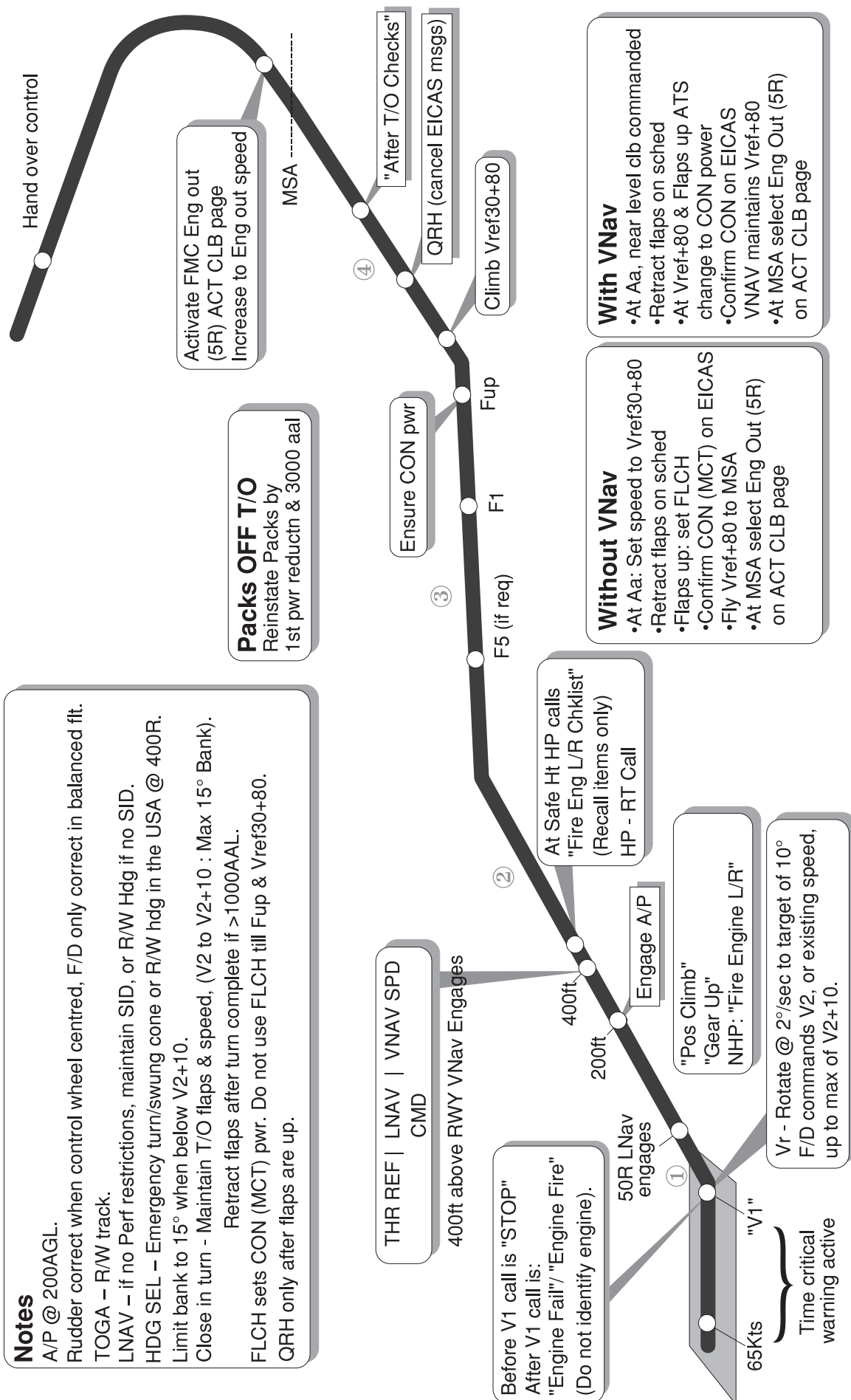
Limit bank to 15° when below V2+10.

Close in turn - Maintain T/O flaps & speed, (V2 to V2+10 : Max 15° Bank).

Retract flaps after turn complete if >1000AAL.

FLCH sets CON (MCT) pwr. Do not use FLCH till Fup & Vref30+80.

QRH only after flaps are up.



**u Eng SVR Damage/Sep L, R**

(QRH 7.8 Jun 10)

- ❖ Airframe vibrations with abnormal eng indications
- ❖ Engine separation

# AUTOTHROTTLE ARM switch .....	OFF
# THRUST LEVER .....	CLOSE
# FUEL CONTROL switch .....	CUT OFF
# ENGINE FIRE switch .....	PULL
<b>Land at nearest suitable airport.</b>	

Note that the severe damage checklist is buried in the unannounced lists. If required, do this checklist, not the ENG FAIL checklist which pops up first.

- ❖ If high airframe vibration after engine shutdown, reduce airspeed & descend without delay. Maintain altitude with acceptable vibration levels.
- ❖ Choice of landing flap: Flap 20 (VREF 20, F5 for G/A) or Flap 30 (VREF 30, F20 for G/A)

**u Eng Lim/Surge/Stall L, R**

(QRH MAN-21-4 May 07 / QRH 7.6 Jun 10)

- ❖ Eng indications abnormal, or approaching limits
- ❖ Abnormal noises (possible airframe vibrations)
- ❖ No response to thrust lever
- ❖ Flames reported in the eng inlets or exhausts

# AUTOTHROTTLE ARM switch .....	OFF
# THRUST LEVER.....	RETARD (till within limits or idle)

- ❖ Correct calls are:–
  - \* NHP “Engine Failure”
  - \* NHP After gear up: “Engine stall Right/Left”
  - \* HP “Engine Limit/Surge/Stall checklist Right/Left”
- ❖ Eng is not necessarily shut down. Access checklist through ECL ‘Engines’ menu.
- ❖ No eng fail is sensed by FMC. So the F/D is not programmed for the EFATO profile and the A/P does not accelerate at Aa. Hence, its recommended that the Aa is entered into the FLAP/ACCEL HT (All Engines) field. (i.e. put it into all 3 fields before T/O). This is particularly important if a non standard Aa is given in CARD.
- ❖ Non recall items completed only after flaps are up.
- ❖ To achieve max thrust on the good engine, (it will default to CLB at 1000ft), disconnect the A/T and use manual thrust.
- ❖ On clean up, speed can accelerate very quickly. Then have situation of one eng not controlled by A/T, and the good eng trying to maintain speed. Leads to staggered T/Levers.
- ❖ Checklist will ask you to increase power. Try to see if can get G/A power.
  - \* If G/A power not available: treat as eng failure and land at nearest.
  - Do not use more than idle reverse on the suspect engine during landing.
  - \* If still popping and banging call for the uENG SVR DAMAGE checklist.
- ❖ Choice of landing flap: Flap 20 (VREF 20, F5 for G/A) or Flap 30 (VREF 30, F20 for G/A)
- ❖ Consider:–
  - \* Putting any emergency turn in Route 2
  - \* Setting the FMC to give flap up speed below MSA.
  - \* TAC will not work with surge

(CJ)

**TAC – Thrust Asymmetry Compensation**

(TM[FC2] 09-20-15 Apr 03)

- ❖ Only available in Normal Mode,
- ❖ If thrust differs by 10% or more – rudder applied to reduce yaw.
- ❖ Amount of rudder proportional to thrust differential.
- ❖ TAC inputs fed back to rudder pedals and trim indicator.
- ❖ TAC not available <70kts on grnd and when reverse applied.
- ❖ TAC will not work if an engine surges

(CJ)

**Wheel to Rudder X-Tie**

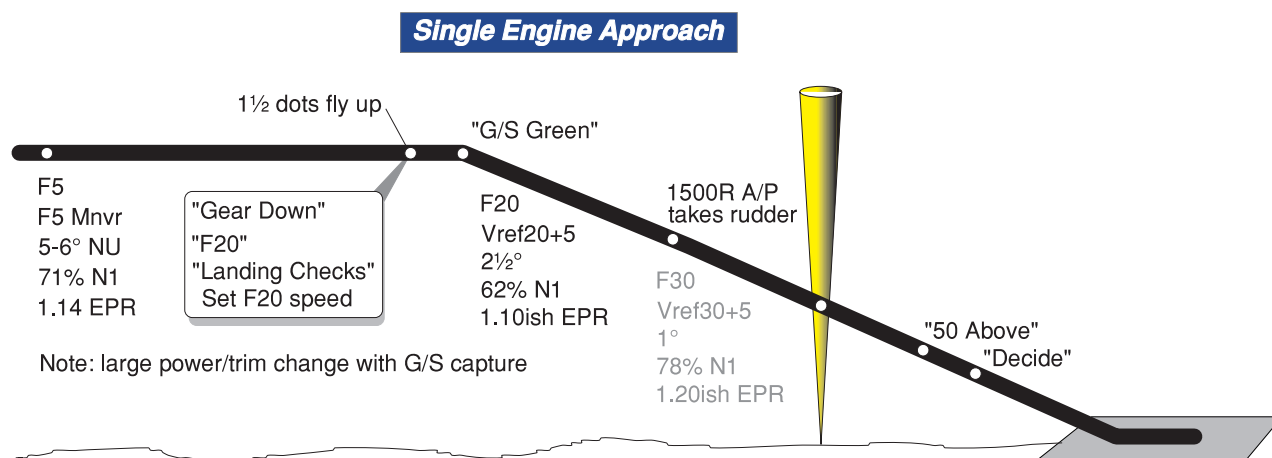
(TM[FC2] 09-20-16 Apr 03)

- ❖ Only available in Normal Mode,
- ❖ Initial effects of eng fail controlled by control wheel.
- ❖ Up to 8° rudder deflection.
- ❖ X-tie operative when < 210kts.

## Single Eng Approach & Landing

(QRH MAN-23-1 May 07)

- ❖ If engine not capable of G/A power – configure for a SE ldg. Only use idle reverse on affected engine.
- ❖ Capt.'s ldg. A/Land recommended. (Do you need A/Land limits in performance man?)
- ❖ Use F20 for ldg / F5 for G/A
- ❖ Avoid RWY with BA Poor, however QRH has figures for this – a good time to use of F30.
- ❖ F30 is available if ldg dist is critical AND G/A performance permits – use is rare e.g. B/Action POOR. See 'Gear Down Ldg Rate of Climb' tables: note the gotcha:– the reference weight is 180 tons. This table tells you if can recover G/S if you get too low on G/P.
- ❖ Landing minima same as 2 engines.
- ❖ Beware of false F/D commands if not in balanced flight. Remove all yaw with rudder.
- ❖ Speed changes don't need rudder inputs, but power changes do, although minimal if TAC working.
- ❖ If auto approach: A/P takes the rudder at 1500R, when the other 2 A/Ps engage and LAND 2/3 annunciated. If A/P disconnected be prepared to apply rudder.  
(QRH PI-13-11 Oct 02 et seq)
- ❖ FM now recommends that manual rudder trim is left IN for man or auto ldg.  
(To remove the manual trim – press the reset btn).  
(Mike Thrower)
- ❖ TAC is cancelled with Reverse Thrust. TAC rudder trim removed on T/down.  
(TM[FC2] 09-20-15 Apr 03)
- ❖ Eng Fail on final approach with F30: OK to continue if landing assured (A/C cleared to land and either visual or conducting a Cat 3 A/Land). If G/A then use F20 for G/A. At Aa retract flaps to F5, continue with SE ops.  
(QRH MAN-23-2 May 07 / R Izon)
- ❖ Note difference between Vref20 approach speed and the F20 manoeuvre speed.
- ❖ Do not use more than idle reverse on a damaged / suspect engine during landing.  
(QRH MAN-23-1 Mar 06)
- ❖ Eng fire: Consider turn towards any fire if HWC, away from any fire if TWC.  
(A[1] 8.11.10 Jun 08)



## Pre-emptive SE Eng Briefing

- ❖ F20 for ldg, Flap 5 for G/A.
- ❖ Reverse Drill on T/Down, – IDLE reverse on available eng. (No speed additive: FULL reverse not req).  
(QRH MAN-23-1 May 07)
- ❖ Use A/Brake 3. (Note that the QRH Ldg Dist Req assumes max man braking + max reverse on live eng)  
(QRH PI-13-10 / PI-23-11 & PI-43-11 Oct 02)
- ❖ At G/S capture, large power/trim change (62% N1, 2 1/2° NU, 3 division trim).
- ❖ Tight pitch control on finals required.

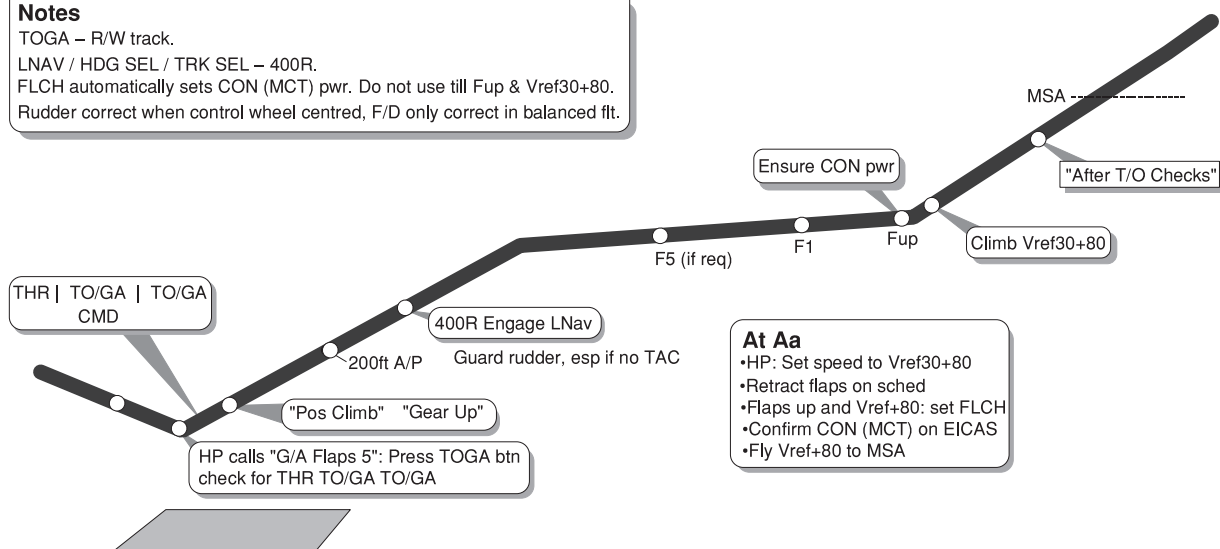
**SE Eng G/A**

(QRH MAN-23-1 May 07)

- ❖ “G/A Flaps 5” —but (“G/A Flaps 20” if F30 used).
  - ❖ Press the TOGA btn!!! This will command 2000fpm ROC, which will be full power.
  - ❖ Push T/Lever all the way to the stops.
  - ❖ Rotate to 10° then follow F/D.
  - ❖ “Positive climb” – “Gear up”
  - ❖ 200 agl engage A/P (if required).
  - ❖ 400R LNAV or HDG SEL/HOLD. (Note: LNAV normally engages at 50R).
  - ❖ For an A/P G/A, the A/P controls the rudder until:–
    - \* Alt capture occurs
    - \* Another pitch or roll mode is selected. (e.g. LNAV at 400R)
    - \* Be prepared to take on manual rudder inputs.
  - ❖ Up to Aa speed cursor should remain at selected final approach speed.
  - ❖ At Aa: set Vref30+80, or F5 speed if staying in circuit. (For F5, don't use FLCH, as it sets CON power – need G/A power).
  - ❖ Retract flaps on schedule. With Flaps up and speed Vref30+80 – FLCH, (automatically sets CON).
  - ❖ If you G/A with F/D's off, TOGA btn will bring F/D's back. But F/D's are removed again when TOGA is disarmed. The thrust limit goes to THR REF!
- The other gotcha is that if an altitude is captured, the a/c will continue to accelerate... So switch on the F/D's after G/A initiated.
- ❖ TOGA mode termination:
    - \* Below 400ft – Autopilot must be disengaged & both F/Ds turned off.
    - \* Above 400ft – When any pitch or roll mode selected, apply rudder if required.

**777 Single Engine Go Around****Notes**

TOGA – R/W track.  
 LNAV / HDG SEL / TRK SEL – 400R.  
 FLCH automatically sets CON (MCT) pwr. Do not use till Fup & Vref30+80.  
 Rudder correct when control wheel centred, F/D only correct in balanced flt.

**Fire Override Switch**

(A Stewart)

Override is unlocked when:–

- \* Fuel Control Switch – Cutoff
- \* Fire handle – illuminated

At all other times need to override. Idea is to prevent shutting down wrong eng if distracted between closing Fuel Control switch and pulling fire handle.

**ECL tips**

(A Stewart)

Checklist basic page, cursor over NN Menu (top RH corner).

1 click → Unannunciated checklist menu

2x clicks → uEng checklist.

- ❖ To complete a checklist, each item on ECL needs a response. Item override is valid response.
- ❖ After each checklist completed call “xxxx checklist complete”. Important when running multiple checklists.
- ❖ Don't need to read out green & Blue checklist items.
- ❖ Only use F5 for G/A when checklist tells you to.

## Electrics

### Approach on S/by power

(QRH MAN-33-1 May 07)

**Indication** Storm Lights on, Lots of EICAS msgs.

**Available on S/by power:–**

- \* • Left navigation radio, CDU, and comms radio,
- \* • Captain's and F/O electronic flight instruments are also available,
- \* • Captain's control wheel trim switches and the alternate trim switches,
- \* • Right inboard and outboard trailing edge flaps indication is available, but trailing edge flap indication on the left side is not.

**Not available on Standby power:–**

- \* • Anti-skid is not available,
- \* • Auto speedbrakes and thrust reversers are not available,
- \* • With the higher approach speed, any excess speed is undesirable.

Fly the approach on speed.

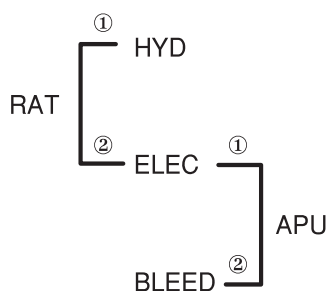
### Tech

RAT deploys when:–

- \* Both TXFR busses dead or
- \* All 3 HYD sys press low or
- \* Dual eng fail + C HYD press low.

APU auto starts when:–

- \* Both TXFR busses dead.



## Engines

RR / GE Differences		
	RR	GE
Spools	3	2
	N3	N2
Start panel	Start selector	Start / Ignition selector
No of autostarts	2	3
Oil temps	Oil temp > -40 for start & > 50°C for T/O (indication amber till 50°C)	No limits given
Fuel tank temp (T/O)	> -37 or > FF pt +3°	None
Auto Door memo msg	Displayed only when in RUN	
Taxi	Very easy to apply too much	
Trim adjustment	Use if EPR derate	None
T/O stand up posn	4 o'clock (E of EPR)	7 o'clock
After T/O	Expect large thrust reduction.	
Normal mode: EEC controls:	EPR	N1
Altn mode: FMC controls:-	N1 (EPR blanks)	N1
Oil System	Has extra oil filter. ENG OIL FILTER L. R ENG OIL PRESS L. R QRH different.	
Ident page on FMC	Trent 895	GE90 - 76B/85B

### EGT Exceedance on T/O

(QRH MAN-21-4 May 07)

- ❖ Occurs at high T/O thrust (hot, high A/Fs and/or temp inversions are additional factors).
- ❖ Consider eng OK for further ops provided:
  - \* EGT is **only** parameter outside limits,
  - \* No other abnormal indications manifested (e.g. fuel flow, vibrations, rpm overspeeds),
  - \* EGT returns to normal after thrust reduction.
- ❖ Retard thrust at safe height, a/c climbing normally but ASAP after gear retraction.
- ❖ Applies if both engines affected and during ETOPS operations.
- ❖ Tech log entry required.

### Abnormal Auto Starts

(QRH 7.4 Mar 09 / FCom1 NP-30-30 May 07)

#### ECAS Msg:

[ ] ENG AUTOSTART L/R

#### Condition:

Autostart has failed to start eng.  
Fuel Cntrl Sw is at RUN with low RPM, with autostart sw OFF

#### Autostart looks after:-

- No EGT
- Hot start
- Hung start
- Compressor stall
- Starter shaft failure
- No N1 rotation
- Insufficient air for starter ops
- Duty cycle time exceeded

#### Pilot looks after:-

- Oil Pressure - increase by initial EGT rise.

Accomplish the ABORTED ENGINE START checklist if there is no oil pressure indication after EGT increases.

# FUEL CONTROL SWITCH .....	CUTOFF
If on grnd	
START / (IGNITION) SELECTOR.....	START
Motor engine for 30 seconds	
START / (IGNITION) SELECTOR.....	NORM

**Abnormal Manual Starts**

(FCom1 SP-7-3 Jun 09)

**Condition:**

- Start parameters exceeded (see table).
- EGT rising rapidly approaching limit during manual start, (hot start).
- No Oil Pressure increase before selecting RUN.

Crew initiated aborted start for the following exceeded parameters:

	GE	RR
Timing	No time given	No time given
“Max Motoring”	Oil Press rise before selecting RUN  Max Motoring = N2 acceler’n < 1% in 5 secs	Oil Press rise before selecting RUN EGT < 100° & Max motoring or > 25% N3 whichever 1st  Max Motoring = N3 acceler’n < 1% in 5 secs
Timing	EGT within 20 sec (2 spools)	EGT within 30 sec (3 spools)
Max EGT	Red Line	Red Line
N1 by ...	50% N2	45% N3
Idle by...	N2 idle within 2 min of RUN	N3 idle within 2 min of RUN

# FUEL CONTROL switch .....CUTOFF If on grnd START / (IGNITION) SELECTOR.....START Motor engine for 30 seconds START / (IGNITION) SELECTOR.....NORM
---

**Engine Ignition & Auto Relight**

(TM[FC2] 7-20-14 Jun 09)

In flt both ignitors are used.

GE engines:

- ❖ When START/IGNITION is in CON, & FUEL CONTROL at RUN, both ignitors operate continuously. On the grnd both ignitors operate continuously when T/O flap set & N1 > 60%
- ❖ When START/IGNITION is in NORM, & flameout detected continuous ignition is automatically applied whenever
  - \* Flap lever is out of UP **or**
  - \* Engine anti-ice is on
- ❖ Flame out detected when rapid decrease in N2 occurs or N2 is less than idle RPM
- ❖ If a sub idle stall detected fuel is shut off for 1 sec to clear stall condition.
- ❖ Continuous ignition is inhibited on the grnd with N1 ≤ 60%

RR Engines

- ❖ Auto relight when eng is at or less than idle RPM & FUEL CONTROL at RUN. Ignitors are activated. If no recovery & eng is below 35% N3, EEC shuts off fuel & disables auto relight.
- ❖ EEC also protects against flameout due to excessive rain/hail ingestion. Ignitors are activated on detection.

**Eng EEC Mode**

(TM[FC2] 07-20-6 Apr 03 / QRH 7.12 May 07)

**EICAS Msg:****[ ] ENG EEC MODE L/R****Condition:**

Affected engine operating in ALTN mode (soft)

Autothrottle ..... Disconnect Thrust Lever (Both)  
 Retard to mid posn (Prevents exceeding limits when ALTN mode selected)  
 EEC mode switches (Both) .....OFF (Do one at a time)  
 (so both engs are controlled to same altn mode & same parameters)  
 Autothrottle .....Engage

Eng EEC Modes			
EEC Mode	NORM	Soft ALTN	Hard ALTN
EEC Mode Switch Posn	NORM	NORM	ALTN
EEC Mode Switch Indication	NORM	ALTN (amber)	ALTN (amber)
How to get to:	Automatic	Automatic	Manually set to ALTN
GE Engs			
N1 ref/ target computed by:-	EEC	FMC	FMC
Thrust limit protection	YES	NO. Can set an N1 that will exceed the Max N1 rating of the eng. 'ENG LIMIT PROT L,R' caution & beeper.	NO. Can set an N1 that will exceed the Max N1 rating of the eng. 'ENG LIMIT PROT L,R' caution & beeper.
Overspeed Protection (N1 & N2 red line). Eicas msg 'ENG RPM LIMITED L, R' displayed.	YES	YES	YES
RR Engs			
RR Engs	EPR	EPR blank	EPR blank
EPR ref target computed by EEC	YES	Not avail	Not avail
Indications	N1:Actual & N1 Red line.	N1:Actual & N1 Red line.	N1: Actual, command, Ref / Target, max & red line.
Thrust limit protection	YES	NO. Can set an N1 that will exceed the Max N1 rating of the eng. 'ENG LIMIT PROT L,R' caution & beeper.	NO. Can set an N1 that will exceed the Max N1 rating of the eng. 'ENG LIMIT PROT L,R' caution & beeper.
Overspeed Protection (N1, N2 & N3 red line). Eicas msg 'ENG RPM LIMITED L, R' displayed.	YES	YES	YES



**u Dual Eng Fail / Stall**

(QRH 7.2 - 7.3 Jun 10)

**EICAS Msg:**

[ ] ENG FAIL L

[ ] ENG FAIL R

**Probable causes:-**

- Engine icing.
- Fuel starvation or contamination.
- Water ingestion.
- Volcanic dust ingestion.
- Bird ingestion.
- Incorrect maintenance action.

# FUEL CONTROL switches (both) .....	CUT OFF, then RUN
# RAM AIR TURBINE switch .....	PUSH (& hold 1 sec)
GE Eng Airspeed set .....	Above 270 kts
RR Eng Airspeed set .....	Above 250 kts

- ❖ For starts above FL300, relights not guaranteed.
- ❖ In flt starts may take up to 2½ mins (GE eng).

**Handling Notes**

- Start APU
- As the flame is out, engine will cool rapidly, settling down to a continuous reduction of 1 deg /sec.
- Engines may accelerate to idle very slowly, especially at high altitudes.
- Do not confuse long start up time with hung start. If N2/N3 increasing & EGT in limits, start is OK.
- GE - for dual in flight start do not abort start manually if EGT display turns red. Auto start allows for this. (EGT turns red when it exceeds the lower red start limit line).
- Use lower EICAS to trace fault. Eng synoptic: will see N3 decreasing, Oil pressure turns red.
- Once an eng is started, use it to reduce the rate of descent!!!!
- Reset the Primary Flt Computers when the HEAT PITOT L+C+R message blanks. A/P then available.
- QRH: What caused flame out? Turbulence, cloud, ice, dumping...?
- Make any turns towards live eng.

**Technical Notes**

- No electrics on RHS, Capt flies A/C. RAT gives P2 ND, PFD, Radio, and the MFD.
- P2 does recall items.
- Moving Fuel Control Switch to CUTOFF arms the Autostart sys.
- No ECL – use the QRH!!!! ECL reboots with the RAT on line. Then need to hunt for checklist.
- To re-engage the A/P, must reset the Primary Flt Computers, PFC. (When the HEAT PITOT L+C+R message blanks)
- RAT may not deploy if APU running, but RAT normally deploys when:-
  - Both TXFR busses dead or
  - All 3 HYD sys press low or
  - Dual eng fail + C HYD press low.
- APU auto starts (Both TXFR busses dead), but takes time. Displays back to normal, with some load shedding.
- Cabin will start to climb, (approx 700 fpm — 1500 fpm depending on age of A/C).

(G Hallett)

**Eng Failure in Cruise**

(QRH MAN-22-1 Mar 03)

- ❖ Engines should only be shut down in flt when required by the QRH. (A[1] 8.11.13 Jun 08)
- ❖ Except in the case of sub-idle, an engine, once shutdown, should not be re-lit unless a greater emergency exists.
- ❖ Only in exceptional circumstances should the Captain not land at the nearest suitable aerodrome after engine shut-down. If Captain decides not to land at the nearest suitable aerodrome, an ASR must be submitted.
- ❖ In a sub-idle situation i.e. eng operating below its min idle RPM and does not respond to thrust lever movement with no limits exceeded & no indication of damage or distress: shut down eng as soon as practicable using the appropriate checklist.
- ❖ Control A/C – TAC provides most input. If TAC inop use 2—3 units rudder trim.
- ❖ Turn away from NAT or high ground, L or R 90°, in Russia turn 30°.
- ❖ Either calls “Eng Fire / Failure”. Both confirm & identify eng & HP calls for:–
  - \* **[ ] FIRE ENG L/R** – EICAS msg. Shut down by recall actions.
  - \* **[ ] ENG FAIL L/R** – EICAS msg, Shut down from QRH, (no recall items for this).
  - \* u Eng SVR Damage/sep – No msg. Shut down by recall actions.
  - \* u Eng Lim/Surge/Stall – No msg, Recall actions but not shut down.

**To descend with VNAV:**

(TM[FC2] 11-31-35 Apr 03)

- ❖ With VNAV PATH engaged:–
  - \* Select ENG OUT> on ACT M.840 CRZ page (5R).
  - \* Set MCP to EO MAX drift down alt or below & EXECUTE. (Don't press the ALT btn).
- ❖ With VNAV ALT engaged:– (G Hallatt)
  - \* Set MCP to EO MAX & PRESS the btn. Get higher rate of descent depending on the loss of speed below EO SPD before btn pressed. Then max of 300fpm.
- ❖ Thrust reference changes to CON & A/T maintain MCT. A/P starts drift down (D/D) in THR | HDG | VNAV SPD.
- ❖ ACT EO D/D displayed. Descends at max of 300 fpm. Time/Dist to EO MAX at 2R.
- ❖ Read the FMA. Ensure CON & VNAV SPD annunciated. Know the VNAV mode you are in.
- ❖ Lights ON.
- ❖ PAN/MAYDAY (inc TRK ID): 121.5/HF. ADS/CPDLC to EMERGENCY. Onward clearance negotiate.
- ❖ Navigate the turn.
- ❖ Start APU. (Max ceiling for start & electrics 43100, max for air 22000).
- ❖ SCCM to F/Deck. Ask Cabin Manager to turn off moving map. PAX PA.
- ❖ When drift down complete change to E/O LRC.
- ❖ If FMC inop use turbulence speeds for descent, (280kts/M0.82). Use QRH for D/D height.

**To descend without VNAV:–**

- ❖ Select ENG OUT> on ACT ECON CRZ page & EXECUTE – ACT EO D/D displayed.
- ❖ Set thrust reference to CON & maintain altitude till speed reduces to FMC EO speed. Descend at this speed.
- ❖ Remain at MCT till LRC speed established.
- ❖ NAT track procedures. With no prior clearance...
- ❖ Turn 90° to assigned track. Track 15 nm from assigned track.
- ❖ With auto bank selected (15° – 20°, varies with TAS) a 180° turn puts you 20nm off track.
- ❖ Descend / climb
  - \* RVSM (290 — 410) clb/descend 500ft, (if @ FL410, climb 1000/descend 500)
  - \* Normal NAT separation clb/descend 1000ft above FL290  
clb/descend 500ft at or below FL290
  - \* Cross subsequent NAT tracks at FL285 or below (or above 410!!).
- ❖ Typical GE DD ≈ FL225 (2 eng max of FL395). For RR DD ≈ FL290 (Max 2 eng FL430; 180 tons).
- ❖ EO speed is min drag.
- ❖ LRC – lower altitude but min fuel consumption.
- ❖ Co Spd (300/M0.80) – min flt time, greater fuel consumption.
- ❖ Capt responsibility to inform Co.. Send diversion report.

(Flt Prog Chart)

**MSAs**

(A[1] 8.3.21.5.1 Jun 08)

- ❖ MSA's quoted by CIRRUS for very long legs is the highest MSA on that leg. This may not be appropriate for the posn at the time of failure. Check en route charts for an accurate MSA.
- ❖ For a Critical Point MSA, ensure that this is not infringed, by checking most carefully the time to the critical point and the expected altitude loss.

**FMC handling**

(G Hallatt &amp; DR)

For a turn off track reprogram the FMC route:–

- Use a RTE Offset of L15 or R15, or R11 in Russia.
- If continuing forward, press LNAV.

If returning :–

- If RTE2 has RTE1 copied into it, ACTIVATE RTE2 & then enter an offset to display the return offset track (dashed line) and TRK SEL over the dashed line. Use RTE2 as it has WPTs behind you, which are required to set up an offset to current leg.
- Alternatively, enter the previous waypoint at the top of the LEGS page. An intercept course is offered at 6R. Enter the reciprocal ITT for the current leg. Select L15 or R15. EXEC and LNAV. Build the rest of the route in a similar manner as time permits..

Note: the lowest FL in NAT MNPS is FL285.

Set up the diversion using the ALTN page or enter airport in DEST line on RTE page.

Note: DREAM, (Diversion Route & Emergency A/F Manual) states that only ‘A’ category airfields may be used for emergency diversions (except in catastrophe).

- ❖ ALTN DIVERT TO – goes direct to waypoint.
- ❖ To enter a route offset need at least two waypoints, (does it need to be an active waypoint?) i.e. direct route won’t work, but entering an intercept does.
- ❖ Try using 30 mile ring on a stored waypoint e.g. 5620N
- ❖ Consider route copy before departure on all flts.
- ❖ At the end of the copied route, enter NAT tracks either side of current track, using route discontinuity to separated the routings.
- ❖ In a diversion use Route PRINT to give a quick CIRRUS plan.
- ❖ Normal MSA band is track  $\pm$  20nm. For RNP5 MSA band width may be reduced to  $\pm$  5nm. (Perf M. 8.0.0B Feb 01).
- ❖ Choose a suitable speed. (Note: if the speed is changed, the MAX ALT will also change !)
- ❖ Terrain a problem?
  - \* Continue with the driftdown speed
- ❖ Terrain no problem?
  - \* Select LRC or CO SPD (usually 300/.80)
  - \* Check and re-select the MAX ALT
  - \* FLCH - closes the T/Lever
  - \* If TAC inop, re-trim
  - \* Consider an altitude below MAX to save the good engine
  - \* When level, choose LRC (min fuel) or CO SPD (min time), re-check MAX ALT and EXEC

**Organised Track System (OTS) thoughts**

- ❖ In some situations turn back manoeuvre may be considered as non urgent and delayed until established safely below FL285 (the bottom of MNPS) or above FL410 (the top). A turn that crosses the OTS should not be initiated until clear above or below.
- ❖ A 15nm offset in the same direction of flight is easily programmed into the FMC without too much heads-down and might be appropriate until descent below FL285 is achieved.
- ❖ The direction of turn should be determined by your position relative to any OTS route (e.g. whether outside, at the edge of, or within the system). Other factors which may affect the direction of turn are:
  - \* Direction to an alternate airport
  - \* Terrain clearance
  - \* Levels allocated on adjacent routes or tracks and...
  - \* Any known SLOP offsets adopted by other nearby traffic.
- ❖ If a 180 degree turn is considered the most appropriate action consider merely pressing the Heading/Track Reference switch, selecting 25° on the Bank Limit Selector switch and winding the index round to the reciprocal track. Experience in the sim shows that at a typical cruise FL the aircraft will roll out approx 15nm parallel to the original track. Use the edge of a 15nm ring centred on the previously passed waypoint entered into the fix page as a guide. When time permits, enter waypoints in the Legs page.
- ❖ In summary:
  - \* Before you enter MNPS airspace have a plan as to how you would descend and divert if it becomes necessary.
  - \* Keep it simple and share it with your colleague(s) before you need to use it.

**Fuel Management.**

Expect **[ ] FUEL IMBALANCE** message to appear. Dumping as required.

The Imbalance msg will appear when the imbalance is ~2000 which takes ~20 mins to balance.

Do not select the landing speeds until any fuel dumping is complete.

Notify Company via ACARS DIVERSION page. The ETL only accurate if route / speeds accurate

## u Volcanic Ash & Dust

(FCom1 SP-25-1 May 07)

- ❖ Flight in areas volcanic activity must be avoided.
- ❖ Flight Crew Briefing or ATC may implement a contingency route (on upwind side).
- ❖ WXR radar not designed to detect ash.

### Symptoms:–

- St Elmo's fire around the windshield
- Bright orange glow in the engine intakes
- Smoke, dust or an acrid odour (similar to electrical smoke) within the cabin/ft deck
- Difficulty with radio comms due to the static field
- A decreasing IAS
- A rise in EGT, with surging / stalls / torching from tailpipe or flameout, all possible.

### Actions:–

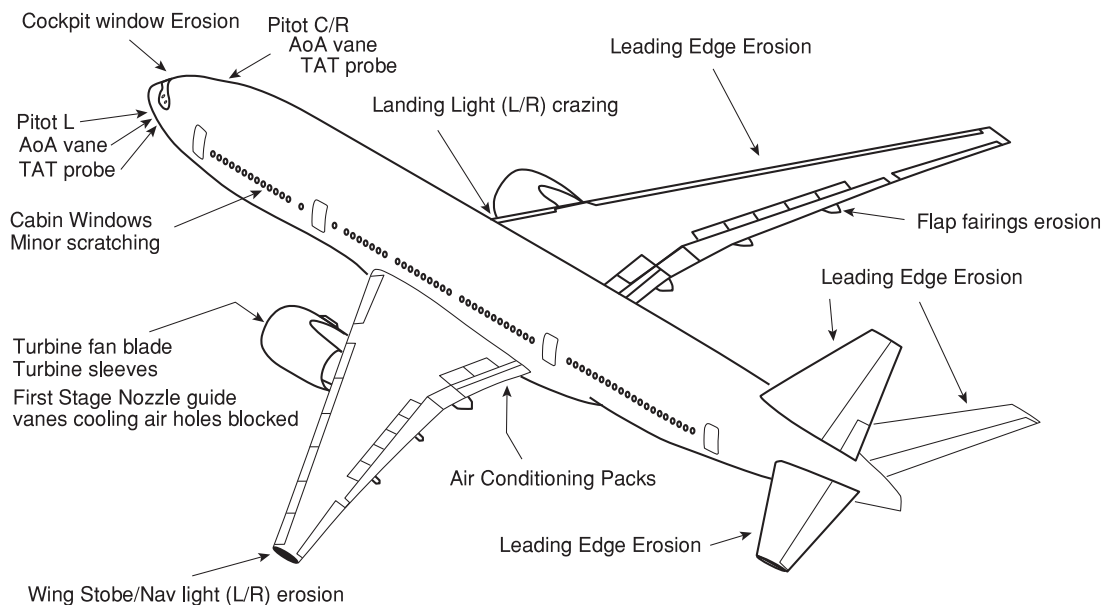
- Exit as quickly as possible — make a 180° turn.
- Disconnect A/T.
- DO NOT INCREASE ENGINE THRUST in an attempt to climb out of the dust.
- Reduce thrust to idle, – improves stall margins, lowers EGT which reduces debris build up on the compressor or turbine guide vanes.
- Switch on engine bleeds. (Eng/Air frame Anti Ice and switch OFF recirc fans). Improves engine stall margin.
- Complete uVOLCANIC ASH checklist, even if you have left ash cloud. (QRH .7.42/44 May 07)
- EPR gauges may be unreliable. {RR engs}.
- Start APU, (electrics backup).
- **EQUIP COOLING OVRD** & **FIRE CARGO AFT/FWD** indications may be present.
- Following engine failure or shutdown, repeated restarts should be attempted immediately. A successful start may not be achieved until the aircraft is clear of the dust and airspeed / altitude are within the air start envelope. Use AUTOSTART.
- Divert to an A/F with L or LR RWY, in case windows are abraded.
- Complete Volcanic ash report and AIREP Special (A[1] 11.6.1.1 Jun 08)

### Flt Instruments/controls:–

- Expect multiple failures.
- Volcanic ash may block the pitot system and result in unreliable airspeed indications. Use IRS ground speed or ATC read outs.
- Establish appropriate pitch attitude. (2.1°NU with 89% N1 @ 37000/200 tons).
- Flt controls may go to secondary mode - No A/P, and ldg with F20 & Vref20.
- Other checklists: Double Eng failure; EEC; Windshear.

### Volcanic Dust:–

- causes rapid erosion & damage to eng internals. Silicon in the ash forms glazing on hot turbine bits.
- abrades leading edges, windscreens, landing lights.



Effects of Volcanic Ash

## Fire Protection

### Fire Eng Tailpipe L/R [#]

(QRH 8.3/4 Jan 09)

<b>Indication:</b>	Tail pipe fire reported.
<b>Probable Cause:</b>	Fuel leak on shutting down or On start up, when excess fuel remains in engine after last use.

Call for the:-

u Fire Eng Tailpipe L/R checklist

# FUEL CONTROL SWITCH .....	CUT OFF
Advise cabin crew	
If bleed air available:	
START / IGNITION SELECTOR .....	START
Advise Tower	
Motor engine till tailpipe fire extinguished	
START / IGNITION SELECTOR .....	NORM

Do not do the Fire Eng checklist as this cuts off the air and cannot motor eng!

### Grd Engineers Procedure

(FC NLetter Dec 95)

- Push back will be stopped.
- Capt informed “Tail pipe flames observed No x Engine”
- Flt Crew to action recall items & QRH.
- Grd Engineer to maintain intercom with crew, and advise the effect of their action.
- If fire extinguisher required it will be discharged into the tail pipe NOT the engine intake.

### Fire Wheel Well

(QRH 8.15 May 07)

<b>EICAS Msg:</b>	<b>[ ] FIRE WHEEL WELL</b>
<b>Indication:</b>	Wheel Well Fire warning & Master caution.
<b>Probable Cause:</b>	Wheel/Brake Fire, Hyd fluid on hot brakes, air from APU/X-body duct.

#### On Ground

- Turn off APU air (pneumatic trunking routes through U/C bay).
- Consider evacuating A/C.
- Inform ATC, stop refuelling. (Incident in BGI – Fuel from bowser sprayed on to hot brakes gave Wheel Well Fire).

(A[1] 2.14.4 Jun 08)

#### In Air

- Observe limits: 270/0.82M
- Make positive effort to get speed below 270kts, & get gear out quickly.
- Land at nearest suitable – check WX. Time of the essence. MAYDAY call.
- In climb use SPD INTERVENE. If this isn't fast enough, use V/S as a pitch mode for a moment or two. (JC)
- Leave gear down for 20 mins after the **FIRE WHEEL WELL** msg has disappeared.
- Terrain considerations - only retract gear for terrain clearance reasons. Wheel well / hydraulic lines may be damaged and retraction may cause further damage or affect gear.
- Check gear & hyd synoptic to see what's left.  
It may well be that tyre pressures on one or more bogies may be zero. Check landing distances, higher auto brake setting.
- NITS briefing to Cabin Manager - get repeat back. Ask them for any evidence of fire.
- Consider A/Land - check RWY status, L, LR or E.
- FMC not programmed for gear down performance. Use gear down ferry figures in QRH.
- Ideally leave gear down for remainder of flt. Only retract gear to extend range to A/F.
- Whenever wheel/tyre overheating/damage is suspected ATC must be alerted to request emergency services to inspect wheels & deal with possible fires. (A[1] 8.12.3 Jun 08)

## Fire Cargo Aft/Fwd

(QRH 8.11/13 Jun 09)

## EICAS Msg:

[ ] FIRE CARGO AFT  
 [ ] FIRE CARGO FWD

## Indication:

Fire Bell; MW lights; EICAS msg (above); CARGO FIRE (FWD or AFT) light (Overhead panel)

## Probable cause:

Smoke or emission from incorrectly packed fruit/veg (which should be sealed in polythene).

(TM[FC2] 08-20-04 Apr 03)

❖ On Grnd, with cargo doors open, do not action checklist, unless fire exists & all personnel clear. (A[1] 8.11.14.1 Jun 08)

In the Air

❖ **Land at nearest suitable A/Field; Time of the essence; MAYDAY.** (A[1] 8.11.3 Jun 08)

❖ Fly @ MMo. Land overweight if required. See **uOVERWEIGHT LANDING** checklist.

❖ If required: use the **uSMOKE REMOVAL** checklist to protect PAX from smoke. (Note: **uSMOKE AIR CONDITIONING** checklist refers to **uSMOKE REMOVAL** but **[ ] FIRE CARGO FWD /AFT** checklist does not).

❖ The **fire** warning is from a **smoke** detector. Check cargo temps (AIR synoptic). Check with CCrew.

❖ Ensure correct switch is armed - both to verify.

❖ Set cabin to 8000ft. This reduces ΔP and decreases flow round cargo compartments and reduces extinguishant leakage out of the compartment.

❖ Start APU. Ensures power to cargo doors after ldg – but not if evacuate!

❖ Land overweight if necessary – no delay.

❖ SCCM NITS:–

- \* N – Cargo fire, which hold? Which PAX zones?  
Fwd Cargo – Zones A/B affected.  
Aft/Bulk Cargo – Zones D/E/F affected.

- \* I – Landing ASAP.

- \* T – Time to land.

- \* S – Standby for possible evacuation? – If fire obvious then evac, else try for steps.  
Brief SCCM to only disarm L doors on command. Remaining doors in auto.  
Move PAX from affected areas.

❖ PA to PAX and brief them. Capt to do this.

❖ If Panic/ Smoke in cabin. Keep door locked. Comms via i/comm.

❖ Reset LDG ALT btn at TOD to restore FMC ldg alt.

❖ The red **FIRE CARGO XXX** EICAS message cannot be cancelled until fire is out.

❖ Dump fuel on descent but don't delay ldg for dumping.

❖ Consider autoland capability? Wx/X-wind? Ldg dist? Reduced flap ldg?

❖ ATC

- \* Advise ATC of BCF/Halon or any dangerous goods in hold (NOTOC).

(A[1] 8.3.1 Jun 08)

- \* Fire service to STBY & not to open holds until PAX & Crew evacuated and fire equipment nearby.

- \* Arrange for steps (as many as poss), to be positioned on LHS.

## After Landing.

- Taxi to suitable area – on or near RWY for steps.
- Before making evacuation decision, get fire service to inspect (but not open) cargo hold.
- Evacuate PAX (via steps if poss) before allowing fire service to open doors.
- Evacuation - suggestion is to brief cabin crew to only disarm 2L & 4L when can see steps arriving. Leave rest of doors in auto.
- If fire still raging, consider evacuation. If fire apparently gone out, consider using steps.
- If steps, L doors to MAN.

These are not recall items.

AFT CARGO FIRE ARM SWITCH .....	ARMED
CARGO FIRE DISCH SWITCH.....	PUSH (1 sec)
LDG ALT SELECTOR.....	PULL, SET 8000

Evacuate lower crew rest compartment & close hatches.

Land at nearest suitable airport.

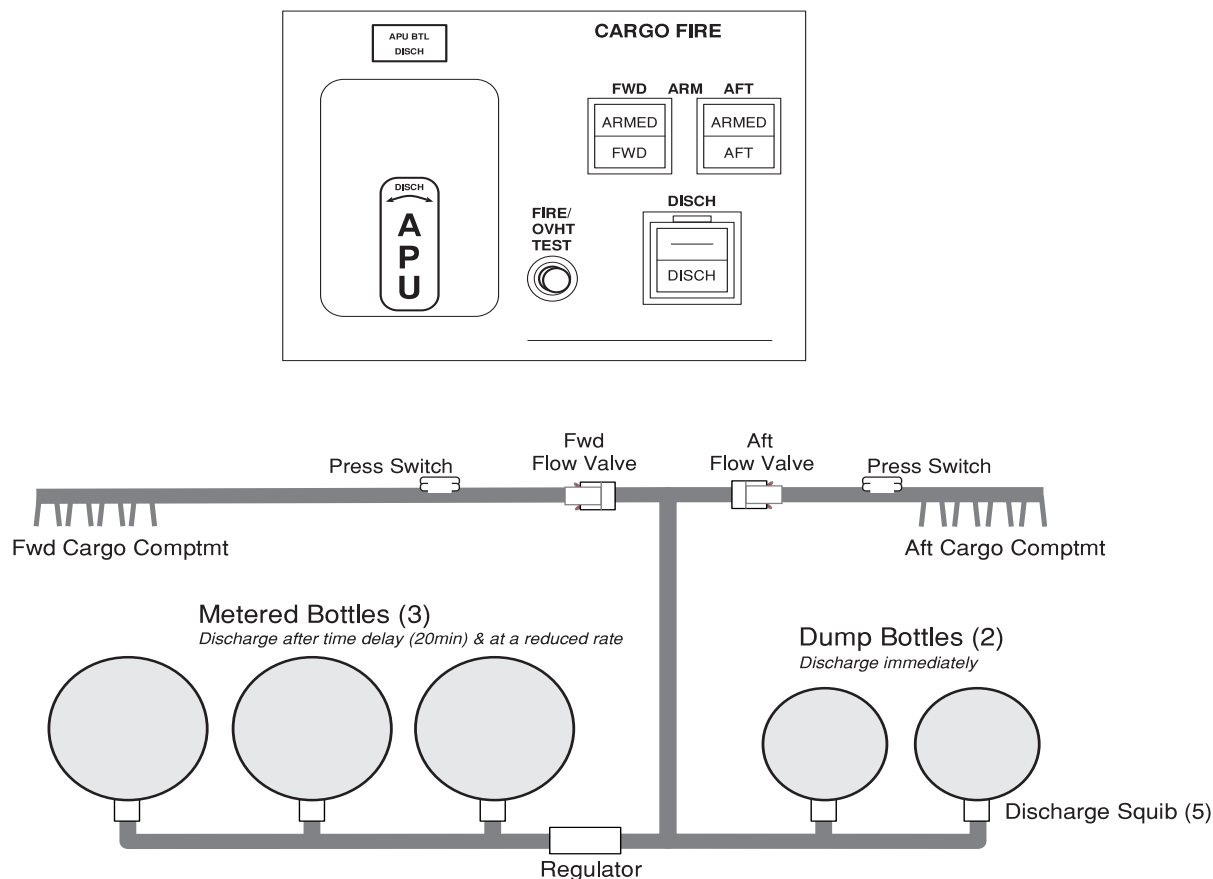
Note: if on grnd with cargo door open, ensure all personnel clear & fire exists before actioning C/list.

FWD CARGO FIRE ARM SWITCH .....	ARMED
CARGO FIRE DISCH SWITCH .....	PUSH (1 sec)
LDG ALT SELECTOR.....	PULL, SET 8000

Land at nearest suitable airport.

Equipment cooling normal mode inop.

Note: if on grnd with cargo door open, ensure all personnel clear & fire exists before actioning C/list

**Technical.**

(TM[FC2] 08-20-4 May 07)

Detectors are **Smoke** detectors. FWD & AFT have 3 zones each. Smoke detection in ANY zone triggers warnings.

5 extinguishing bottles in total; 2 dump bottles and 3 metered.

Arm switch:–

- arms all fire bottle and flow valve squibs,
- arms the selected compartment extinguishing valve,
- turns off both lower recirc fans,
- shuts down cargo heat,
- commands packs to min air flow required for pressurisation,
- shuts down bulk cargo ventilation; **CARGO FIRE AFT** warning light,
- shuts down lav/galley vent fan; **CARGO FIRE AFT** warning light,
- Equip cooling to OVRD mode; **CARGO FIRE FWD** warning light.

After 30 mins at low alt & low pressure diff, electronics and screens may fail.

Pushing the discharge switch causes the immediate total discharge of the two “dump” bottles and starts a timer in ELMS. The metered bottles discharge:–

- If the aircraft is on the ground one metered bottle will discharge after 20 min.
- If the aircraft is airborne but lands within 20 min one metered bottle will discharge on landing.
- If the aircraft is airborne after 20 min all three metered bottles discharge over a 180 min period.
- The Cargo Fire DISCH switch illuminates when the dump bottles start to discharge; the EICAS advisory **BOTTLE DISCH CARGO** is displayed when they have completely discharged.



**u Smoke, Fire or Fumes**

(QRH 8.6 Jun 09)

# O2 MASKS (if req) .....	ON
# CREW COMMS (if req) .....	ESTABLISH
Isolate power from ignition source	
If smoke persists land at nearest suitable asap.	

- ❖ To protect F/Deck - keep door closed and communicate by interphone. What sort of smoke? Colour/smell?. Can they see fire or just smoke? (There is a difference). Need to know whether fire is forward or aft of midwing,
- ❖ Can you find appropriate switches in the dark?
- ❖ Turn up all the lights to help visibility.
- ❖ 1st class seats can be isolated individually at the back, but seat needs to be cranked up for landing. Can take up to 1½ hrs to crank all of them to ldg position if all have been isolated from main switch.
- ❖ Consider getting P2 to run checklist as panel above his head - unless P2 has to fly a/c of course.
- ❖ Get ATC to give speed & height info.
- ❖ The intercom switch has to be ON to use mask mike!!!
- ❖ Speaker on to assist communication?
- ❖ Any blue circle on the ND is 5000ft long (1524m).
- ❖ Open flt deck window to clear smoke/fumes?

**u Smoke/Fumes Removal**

(QRH 8.18 Jun 09)

O2 MASKS (if req) .....	ON
CREW COMMS (if req) .....	ESTABLISH
FLT DECK DOOR .....	CLOSE

- ❖ Do this c/list only when directed by Smoke, Fire, Fumes c/list
- ❖ Do not delay ldg to complete this c/list
- ❖ Need to know whether fire is forward or aft of midwing in order to close the correct outflow valve.
- ❖ If only one outflow valve in AUTO, can take 1 to 2 mins for A/C to depressurise on landing. When stopped, open other valve manually in order to open doors quickly. (CJ)
- ❖ EQUIPMENT COOLING is OFF. On landing, with no airflow, get instrument warning and noise in electrics bay. Switch off ADIRU? (CJ)

**Smoke Fumes Incident**

(A[2] 4.19.11 Jun 08)

The post flight actions following smoke/fumes inhalation requiring the use of oxygen masks, or when any one of the crew reports feeling unwell or has physiological symptoms, needs to be carefully reviewed once on the ground. This review should include consultation with the cabin crew if required and result in the following actions:

- a) The Captain must contact and debrief Fleet Management ASAP. A determination as to whether any crew member felt unwell or their performance was adversely affected should be made.
- b) Flight crew who have detected smoke / fumes but have not experienced any symptoms would should normally remain fit for continued flying duties. The Duty Flight Crew Manager should seek advice from BAHS if uncertain of a crew members fitness to fly,
- c) Any flight crew who has experienced symptoms due to the incident is to be removed from flying duties until assessed fit by BAHS. The other operating flight crew should also be removed from flying duties until return to duty is approved by the Fleet Management.

All accidents and medical incidents which occur in flight, whether involving crew or PAX, must reported by completing an 'Incident Form'. If any crew member incapacitated – ASR.



**Smoke / Fire in Flight**

(Flight Deck Mag #34 Spring 2000 / AIC 131/1999)

**Statistically, you have a 2 minute time frame to extinguish a cabin or cargo fire. After that time it will be uncontrollable. You will then have a further 12 mins to land or ditch the aircraft (i.e. 14 mins max).**

- ❖ Treat any fire in flight as an extreme emergency.
- ❖ If the warning is credible (detectable smoke or flame) start diversion immediately.
- ❖ Declare emergency - don't ask permission, tell ATC your actions.
- ❖ Do not dump - its not necessary and wastes time - if ditching may help flotation.
- ❖ Complete essential / abnormal emergency checklists en route.
- ❖ Unless loss of control likely, do not diagnose problem until tracking towards diversion A/F, and all checks complete as far as possible.
- ❖ Procedures should not be rushed such that the situation is exacerbated.
- ❖ Prioritise requirements dictated by the situation. Don't waste time on non essentials.
- ❖ Overweight landing is probable - use the overweight landing checklist.

**Fire over water**

- Pray this does not happen to you:—)
  - If the warning is credible, immediately prepare for a ditching - that means an emergency descent.
  - Hope your fire fighting is effective before putting it on the water...
  - If the warning is not credible - you have a major problem. (Which is why you earn lots!)
- Do you ask for a visual confirmation from other aircraft? Request intercept?
- Do you know your cargo - flowers in the hold?

**Ditching**

(QRH 0.1 Jan 09)

- If time jettison fuel.
- There are two distinct wave patterns. A major one, caused by the ocean movement and a minor one, caused by the wind. The major one gives deep troughs, whilst the minor waves are impressed on the major waves. If there are breakers, then the white foam will fall down the backside of the wave leaving a streak that points into wind.
- The best technique is to land parallel to the major waves and as close to the wind as possible. Land on top of the wave as it passes under you.
- Below 5000ft PACKS to OFF to depressurise A/C
- Close OUTFLOW valves to seal A/C
- DO NOT EXTEND THE GEAR, use F30, Vref30
- Fly the aircraft onto the water with minimum speed and min rate of descent. Close the thrust levers on contact with the water.
- After impact FUEL CNTL SWS to CUTOFF to unlock PAX doors.
- Provided the ditching is successful, then the aircraft will float for a long time.

**Fire over remote land areas**

- With no suitable airfield, consider landing on water rather than unsuitable terrain.
- Depth perception over water is difficult, use the Rad Alt.
- Salt lake flats are good places to set an aircraft down.

(MD test pilot)

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## Fire / Emergency Rapid Approach

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This has been shown to work well in the Sim.

( CJ & CC)

- ❖ Aim for 320kts at 13d,  $\pm$  1d for every 1000ft density altitude.
- ❖ At 13d
  - \* Set Speed bug to the Flap Up speed
  - \* Full speed brake
  - \* Gear down at 270kts
- ❖ At the Up bug
  - \* Stow Speed brake
  - \* Select flaps on schedule
- ❖ In the slot at 1500ft on the glide path.

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## All Engines Out Approach

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This has been shown to work well in the Sim.

( CJ & CC)

Aim for:

- ❖ 10d  $\pm$  1d for every 1000ft density altitude.
- ❖ 300kts
- ❖ 3000ft
- ❖ Clean
- ❖ On Glide slope
- ❖ Allow for HWC
- ❖ Autoland if possible

## Flaps & Slats

### Flaps Technical

(TM[FC2] 09-20-18 Apr 03)

		<----- 3 x FCUs ----->		
Modes:–		PRIMARY	SECONDARY	ALTN
Slats (LE)	}	C Hyd	Electric	Electric
Flaps (TE)	}	C Hyd	Electric	Electric

#### Primary Mode (C Hydraulics)

- Flaps and slats operate independently. Slats are first to extend & last to retract.
- Inhibited from moving if >20000ft or if A model >250kts, or B model >265kts.
- Flap & slat asymmetry & uncommanded flap/slat motion protection.
- Flaps Load relief operates if flaps between F15 thru F30. Relief retraction limited to Flaps 5.
- Slats Load relief not required in primary mode.
- Autoslats armed at F1 thru F20 (Sealed). Stall warning system signals move to the Gapped position.
- Autoslats only work in Primary mode.

1 = Slats midrange (Sealed)		} AutoSlat Protection.
5 = Slats midrange (Sealed), Flaps 5	}	} Signalled by
15 = Slats midrange (Sealed), Flaps 15	} T/O Range	} Stall warn sys to
20 = Slats midrange (Sealed), Flaps 20	}	} move to Gapped posn.
25 = Slats full down ( <b>Gapped</b> ), Flaps 25		
30 = Slats full down ( <b>Gapped</b> ), Flaps 30		

#### Secondary Mode (Electrical)

- **FLAPS PRIMARY FAIL** or **SLATS PRIMARY FAIL** caution msg.
- Automatically switches to Altn mode when Primary mode detects a failure.
- Flap selection still controlled by normal flap lever.
- Flaps and Slats operate independently – but slowly (electric motor).
- EICAS expanded slat/flap posn indicator appears.
- No autoslats hence slats are Gapped at all flap positions if A model <215kts, B model <239kts. They retract to the midrange (Sealed) position if these speeds are exceeded. If slats are Sealed (F1 thru F20) when secondary mode is entered, they stay at the Sealed position until flaps selected UP or >F20.
- Slat load relief retracts slats from Gapped to Sealed if speed: > 215kts (A model); >239kts (B model).
- Use F20 and Vref20 for ldg.

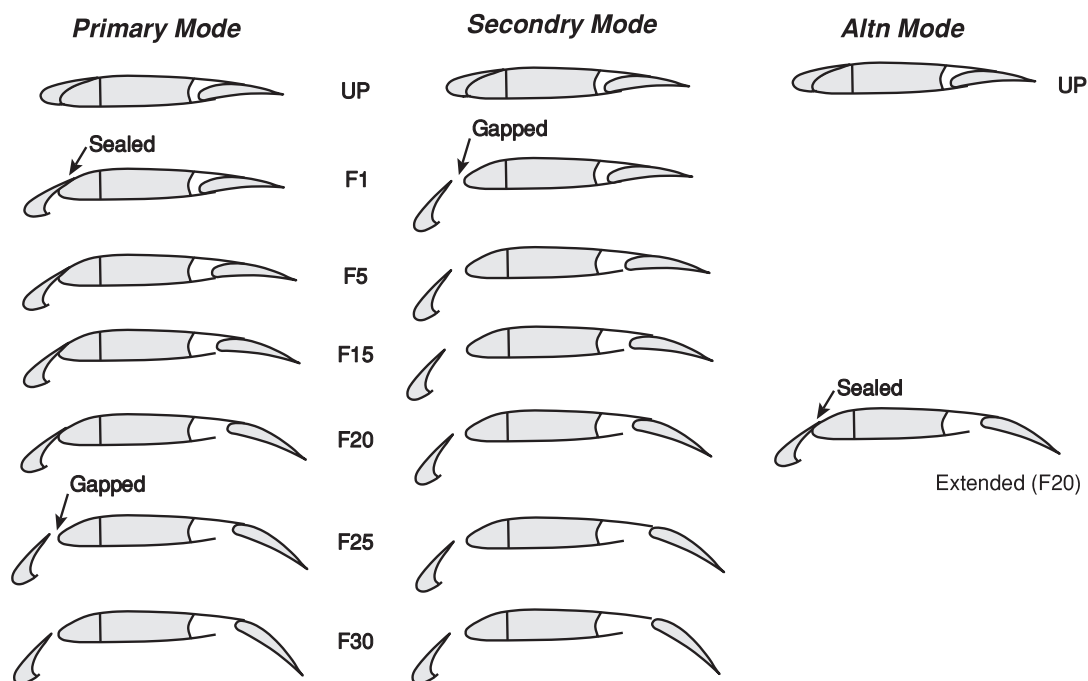
#### Altn Mode (Electrical)

- Use the Altn Flap ARM switch to ARM Altn mode.
- Flaps and Slats DO NOT operate independently. They move slowly (using same electric motors as secondary mode).
- Flap lever disabled & no longer controls flaps.
- Extend – Slats and Flaps move simultaneously. Slats limited to midrange (Sealed) and Flaps to F20.
- Retract – Flaps move fully up before Slats move up.
- No protection: i.e. No Asymmetry or uncommanded motion protection, flap/slat load relief, or autoslats.
- Use F20 and Vref20 for ldg.
- Flap indications do not turn green. Flap position not sensed - not ticked off on ECL – item override.

#### Speed setting with Secondary or Altn Flap Modes

Since flap extension takes longer it is recommended to keep the airspeed as it is until the desired flap setting is reached - otherwise you can be flying too slowly for the current configuration, especially if distracted. (QRH MAN-34-2 Mar 06)

Flap/Slat modes			
	Primary Mode	Secondary Mode	Alternate Mode
Power	Hydraulic (C)	Electric (L & R AC) Inhibited on grd	Electric (L & R AC) Disables flap lever
Function	Normal Ops Normal flap display.  Full travel.  Flap/Slats operate independently	Automatically engaged. Expanded flap display.  Full travel, but F20, Vref20 for ldg.  Flap/Slats operate independently Ops time increased (FUp to F1 – 2 min F5 to F20 – 1 min)	Manually engaged & operated. Expanded flap display (index marks at all posns & 5°, 20° labels). Flaps limited to 20° Slats limited to Sealed. Flap/Slats operate together, but Slat retraction inhibited till flaps are UP. Ops time increased
Protection	Autoslats (At F1,5,15,20 – stall signal moves slats from sealed to gapped). Flap load relief (F15–F30(EF5)). NO Slat load relief, (not req).  Slats sealed @ F1,5,15,20. Slats gapped @ F 25,30. Assym protection. Uncommanded motion (FLAPS or SLATS PRIMARY FAIL, secondary mode engaged)	No Autoslats Therefore slats are gapped @ F1.  NO Flap load relief. Slat load relief, (gapped → sealed)  Slats gapped at all flap posns.  Assym protection. Uncommanded motion (If continues - get FLAPS/SLATS DRIVE)	No Autoslats  NO Flap load relief. NO Slat load relief.  Slats sealed.  No Assym protection.



**[ ] Flaps Primary Fail**

(QRH 9.4 Mar 09 / QRH MAN-34-1 May 07)

**EICAS Caution Msg:****[ ] FLAPS PRIMARY FAIL****Condition:**

Primary (hyd) flap drive failure. Flap operating in secondary (elec) mode.

**Indication:**

Expanded flap display.

**MEL:**

No dispatch!!!

**QRH**

- Plan additional time for approach. Up—F5  $\approx$  4min,  
F5—F20  $\approx$  1 min.
- Since flap extension takes longer it is recommended to keep the airspeed as it is until the desired flap setting is reached - otherwise you can be flying too slowly for the current configuration, especially if distracted. (QRH MAN-34-2 Mar 06)
- Use F20 & Vref20 for ldg. Keep F20 for the G/A. (F30 not used due slow retraction required for G/A).
- Flap load relief not available in secondary mode.
- Sit on hands for this one as may get **[ ] FLAPS DRIVE** msg.

**[ ] Flap/Slat Control**

(QRH 9.5 Mar 09 / QRH MAN-34-1 Mar 03)

**EICAS Caution Msg:****[ ] FLAP/SLAT CONTROL****Condition:**

Flap/Slat computer control fault/failure or Altn flaps have been armed. Use the ALTN system.

**Indication:**

Expanded flap display.

**MEL:**

No dispatch!!!

**QRH**

- Retraction - Monitor speeds during retraction.
- Use F20 & Vref20 for landing, (ALTN mode).
- Plan additional time for approach. Up—F5  $\approx$  4min,  
F5—F20  $\approx$  1 mins.

**Handling Notes**

- Max flap available in ALTN mode is F20.
- ALTN Extension – Do not reduce speed until the next flap setting achieved.
- ALTN Retracting – get expanded display, and flaps can be allowed to retract continuously, and speed adjusted accordingly.
- It takes a long time to retract, (4 mins) so its easy to get distracted. The last bit happens all at a rush, so watch the speed.
- ALTN expanded display labels the F20 and F5 positions, with 5° divisions in between.
- Use F20 & Vref20 for ldg. Keep F20 for the G/A. (F30 not used due slow retraction required for G/A).
- Trap for young players. It is likely that the **[ ] FLAP/SLAT CONTROL** EICAS message will appear after a selection of flap. After following the ECL the flap lever may be inadvertently left selected. It is important to select Flap UP to set Vmo correctly on the speed tape.

## [ ] Flaps Drive

(QRH 9.3 May 07 / QRH MAN-34-1 May 07)

### EICAS Caution Msg:

**[ ] FLAPS DRIVE**

### Condition:

Primary & Secondary flap drives have failed to operate or have been shut down due to flap asymmetry, skew / loss, disagree or uncommanded motion detected.  
A flap problem that cannot be corrected by electric system. (Altn sys not used).

### Indication:

Expanded flap display.

### MEL:

No dispatch!!!

### Confusion

First message is often **[ ] FLAPS PRIMARY FAIL**. This indicates primary system has failed to move the flaps. The secondary system then tries to move the flaps; if this fails, the message **[ ] FLAPS DRIVE** will appear. The ECL will direct you to correct checklist.

### QRH

- Do not try to move flaps.
- **Do not use ALTN flaps – No asymmetry protection. Do not do FLAPS PRIMARY FAIL checklist.**
- Use either Flap 1 or current flap.
- Approach speed depends on the available flap.  
Flap 5 or less: Position flap lever to 1 and use Vref30+40, ensure slats extended,  
Flap between 5 & 20: Use current flap & Vref30+20,  
Flap 20 or greater: Use current flap & Vref20.  
(This is the only checklist resulting in a partial flap ldg of <F20).
- Do not use FMC fuel predictions.
- Refer QRH for ldg dist

(QRH PI-11-1 / PI-21-1 / PI-41-1 et seq)

### Handling Notes

- On lowering flaps, the flap indicator stays magenta & does not go green when flaps are in position.
- A/P is available, but A/Land is NOT available with less than F20. (FCom1 L-10-5 Jun 09)
- Flap load relief not available.
- Adjusted Vref allows full manoeuvring during approach phase. Apply normal wind additives (5kts if A/T used) to give full manoeuvring in ldg config. (QRH MAN-34-1 May 07)

### Approach & Landing

- Brief for full reverse as have speed additive. (Perf M. 4-1-3 Feb 97)
- Pitch attitude on final with asymmetric TE flaps is several degrees higher than normal (approx 4–5°).
- Use normal wind additives, (Vref+5 with A/T).
- With A/P coupled to ILS still get **LAND 3** annunciated.
- If speed reduces to Vref, 40° bank is not available.
- Do not allow speed to go below Vref during flare – danger of tail scrape (10°).
- Do not float – fly onto RWY. Very little flare. Use full reverse.
- A/Brake is OK – use a higher setting.

**[ ] Slats Drive**

(QRH 9.14 Mar 09 / QRH MAN-34-1 May 07)

**EICAS Caution Msg:****[ ] SLATS DRIVE****Condition:**

Primary & Secondary slat drives have failed to operate or have been shut down due to Slat asymmetry, skew / loss, disagree or uncommanded motion detected.  
A slat problem that cannot be corrected by electric system. (Altn sys not used).

**Indication:**

Expanded flap display.

**MEL:**

No dispatch!!!

**QRH**

- Do not try to move slats. Do not use ALTN Flap mode - No asymmetry or uncommanded motion protection.
- Do not do SLATS PRIMARY FAIL checklist.
- Flap limited to F20 if slats not fully extended.
- Do not use FMC fuel predictions.
- Use F20 + Vref30+30, for better handling qualities when slats not fully extended.
- Do not float.
- **Do NOT use A/Land.**
- Refer QRH for ldg dist.
- QRH caters for most extreme case of no slats on one wing.

(FCom1 L-10-5 Jun 09)

**Approach & Landing**

- Brief for full reverse as have speed additive.
- On lowering slats, the slat indicator stays magenta & does not go green when slats are in position.
- Pitch attitude on touch down less than normal.
- Do not float. Fly onto the runway. Use full reverse.

(PerfM. 4-1-3 Feb 97)

**[ ] Slats Primary Fail**

(QRH 9.15 Mar 09 / QRH MAN-34-1 May 07)

**EICAS Caution Msg:****[ ] SLATS PRIMARY FAIL****Condition:**

Primary (hyd) slat drive failure. Slats operating in secondary (elec) mode..

**Indication:**

Expanded flap display.

**MEL:**

No dispatch!!!

**QRH**

- Plan additional time for slower slat operation. Up-F1 ~ 2 min.
- Note G/A will be at F20. Do not use F5 unless checklist specifies this.
- Slats extend beyond midrange when speed < 215kts (A model) or < 239kts (B model).
- For G/A do not exceed 215kts (A model) or 239kts (B model) until slats retract to midrange.

## Flight Controls

### [ ] Stabilizer

(QRH 9.1 May 07)

**Condition:** Uncommanded stabiliser motion detected  
Stabiliser inop.

# STAB CUTOUT SWITCHES (Both) .....CUTOUT  
# DO NOT EXCEED CURRENT SPEED.

After have shut off hydraulics, try manual trim.

Use Flaps 20 & VREF 30+20 for Idg. Provides sufficient elevator control.

### Frozen/Jammed Flt Controls

- ❖ Before trying to 'break out' the controls, if possible, ensure cabin is secure.
- ❖ Use any force required to free jammed controls.

(A[1] 8.11.15 Jun 08)

### Flight Control Modes

(TM[FC2] 09-20-05 Apr 03)

System		NORMAL Mode	SECONDARY	DIRECT
Fault	Norm (A/P): A/P-PFC-ACE-Sfcs Norm (Man): Ctrl-ACE-PFC-ACE-Sfcs Sec (Man): Ctrl-ACE-PFC(basic)-ACE-Sfcs Direct (Man): Ctrl-ACE-sfcs		Loss of air data, inertial data or internal fault.	Loss of 3 PFCs, no comms with PFCs, or PFC disc sw.
EICAS			<b>FLT CONTROL MODE</b>	<b>PRI FLT COMPUTERS</b>
	Autopilot	✓	✗	✗
	Auto speedbrake	✓	✗	✗
Envelope Protection	Stall protection	✓	✗	✗
	Overspeed protection	✓	✗	✗
	Bank angle protection	✓	✗	✗
Yaw Control	Gust suppression	✓	✗	✗
	TAC (10% differential thrust)	✓	✗	✗
	Yaw damper	✓	Degraded or inop	✗
	Manual rudder trim cancel switch	✓	✓	✗
	Rudder/wheel crosstie (<210kts)	✓	✗	✗
Pitch Control	Pitch compensation for:- thrust changes, gear and configuration changes, turbulence, turns up to 30° bank	✓	✗	✗
	Primary Pitch trim (Cntrl Col) (Switches inhibited with AP engaged)	<b>In the air:</b> Column switch or altn pitch trim levers change ref airspeed. Elevator and stab positioned automatically. <b>On the ground:</b> Stab directly positioned.	Primary Trim switches or alternate trim levers move stabilizer directly.	
	Alternate pitch trim levers (DO NOT use with AP engaged, as it will run trim & AP will NOT disconnect). Has authority over wheel switches in all modes. Moves stabilizer directly, via cables.	Changes trim reference airspeed.	Does not change trim ref airspeed.	
	Elevator feel	Continuously changes through airspeed envelope.	Two feel levels, which changes according to flap up or not up.	
	Rudder ratio			



## Flight with Unreliable Airspeed Indications (Airspeed Unreliable)

(QRH 10.1 / QRH MAN-30-1 Jun 09)

### EICAS Caution Msg:

(One or more of)

AIRSPEED LOW

GRD PROX SYS

OVERSPEED

NAV AIR DATA SYS

HEAT PITOT L

HEAT PITOT C

HEAT PITOT R

HEAT PITOT L+C+R

SGL SOURCE AIR DATA

SGL SOURCE DISPLAYS

WINDSHEAR SYS

### Condition:

Blocked or frozen pitot system. Radome loss or damage.

### Indication:

Unreliable airspeed (blank or fluctuating displays), speed stability problems, pitch/power settings inconsistent with speed/altitude, airspeed failure flags, PFD current airspeed box amber, PFD flight mode annunciators with amber lines, overspeed indications, simultaneous overspeed & stall warnings.

# PITCH ATTITUDE & THRUST .....	CHECK
IF NOT NORMAL:	
# A/P & A/T .....	DISCONNECT
# FLIGHT DIRECTORS (both) .....	OFF
# PITCH ATTITUDE & THRUST .....	ADJUST

- ❖ If IAS < 50kts, flt control system reverts to secondary mode, which does not depend on airspeed.
- ❖ Disengage A/T, as it uses IAS. (If Flight Control Mode changes to Secondary, then A/P is not available)
- ❖ DO NOT re-engage a speed mode
- ❖ Lose EPR on RR engs.
- ❖ Can use Flt Path Vector (FPV) as this relies on inertial sources, although if altimeters are misreading, then FPV vertical information may also be inaccurate
- ❖ Know typical Pitch/Power settings. (See also tables in QRH Perf Inflight section)
  - \* Climb: 9—11° NU at SL; reducing to 4°NU at FL300. CLB power.
  - \* Level flight: 2—4° NU & 77—95% N1 or 1.2—1.35 EPR
  - \* Descent (Clean) 2° NU to ½ degree ND at Idle power.
  - \* Angle of attack (AoA) of 5° equivalent to min manoeuvre speed for current flap setting, regardless of flying level, climbing or descending. At approx 5° time to take more flap?
  - \* AoA information is still available on Flt Controls Maint Page, as info comes directly from AoA vanes
- ❖ Very funny effects with blocked tubes. ASI can give erroneous signals with **VERY POWERFUL** illusions. Best to cover ASI.
- ❖ Standby ASI may also be in error. However, only speed related items are u/s.
  - \* FLCH and A/T are u/s.
  - \* Reference & maximum N1 / EPR may be unreliable.
  - \* Wind readout is unreliable
  - \* ALT HOLD and V/S should be OK, but may be unreliable.
  - \* HDG, TRK, Ground speed sensed by inertial system, so should be OK
- ❖ Handling:
  - \* Fly level and try A/P & F/D. Now fly pitch by adjusting power. Use QRH to extract pitch / power setting. See Flight with Unreliable Air Speed / Turbulent Air Penetration tables. (QRH PI-10-1 / PI-20-1 / PI-40-1 et seq)
  - \* If pitch>book then too slow. Use handful of power to correct pitch then set book power.
- ❖ Can use Ground speed from ND or ATC Radar. Note any forecast wind & interpolate IAS.
- ❖ Descent: To 10,000ft fly body angle, check descent rate from QRH PI pages. Reduce R of D to 1000fpm at 2000ft above level off.
- ❖ Maintain visual conditions if possible.
- ❖ Make a long stable approach, ideally an ILS or long straight in.
- ❖ Make all power/config changes slowly & let them take effect before changing something else.
- ❖ Hardest part is to transition to the G/Slope. Suggest establish ILS clean. At 1½ dots select gear down & F20. (Gear down and F30 are major config changes - not really catered for in the QRH).
- ❖ Capture G/Slope & take F30. Reduce handful of power. Let speed reduce till correct pitch achieved & set book power. (A/P will blindly follow G/S). Use power to adjust pitch. Eventually the ASI will fall into the lower red band on the PFD, & A/P drops to off. Now nail book attitude and adjust R of D & glidepath with power.
- ❖ Problems with Flight Control System & trimming whilst still in primary mode. Goes to secondary mode when IAS drops below 50kts which is not dependant on airspeed.
- ❖ QRH only has level flight with Gear up & Flap 20. If you then go to gear down & descend on the ILS it is a major config /power change. (In the sim this caused the biggest problems during fly outs).
- ❖ Landing: Do not float or hold off. Positively fly onto the RWY. Use Autobrake if available.
- ❖ Note: if A/C parked for extended periods in the tropics, without pitot covers, may get insects inside the tubes.

## Stall Recognition & Recovery

**Condition:** Stalled

(QRH MAN-1-1 Mar 08)

**Indication:**

- Continuous stick shaker, with one or more of:–
- buffeting, heavy at times
- lack of pitch authority and/or roll control
- unable to arrest descent rate

**Recovery:**

- ❖ Thrust levers to Max; smoothly adjust pitch (below horizon if necessary) allowing for proximity of ground/obstacles. Level wings. Do NOT change config. Speed brakes stowed. Generally, use nose down elevator until recovery is complete and stick shaker ceases.
- ❖ NHP should call any omissions to above as well as trends in airspeed, altitude & flight path, particularly if ground contact is a factor.
- ❖ A stalled condition can happen at any attitude.

## Flight with Unusual Attitudes (Upset Recovery)

### Causes of Aeroplane Upsets

(QRH MAN-1-10 May 07)

- ❖ Environmentally induced:  
Turbulence, CAT, mountain wave, windshear, thunderstorms, microbursts, wake turbulence, & icing. i.e. AVOID these!
- ❖ Systems-anomalies induced:  
Flight instruments, autoflight systems, and flight control anomalies.
- ❖ Pilot induced:  
Instrument x-check, inattention/distraction from cockpit duties, vertigo/spatial disorientation, & improper use of automatics.

### Definition

The unintentional Exceedance of:–

- ❖ pitch attitude > 25° NU or pitch attitude > 10° ND or bank angle > 45° or
- ❖ flying within the above parameters but at inappropriate speed for the conditions.

### Initial Actions

- ❖ Determine attitude/speed. The PFD is the primary reference. Do not fixate on one indication.
- ❖ Disengage A/P & A/T - fly manually.
- ❖ If the A/C is fully stalled, deal with that first. Do not confuse an approach to stall as a full stall.
- ❖ Do not try to troubleshoot the cause. Deal with the existing situation.

### Nose-High Recovery

Situation: Attitude > 25° NU; airspeed decreasing rapidly; ability to manoeuvre decreasing. (Control pitch before roll)

- ❖ Apply as much as full nose down elevator. (This also unloads the wing and prevents stall, improves roll control).
- ❖ If required, sparingly use nose down stab trim if stick forces are high. Stop trimming when g forces or elevator forces are reduced.
- ❖ Adjust any bank angle to achieve a nose down pitch rate or if level, roll to obtain a nose down pitch rate.
- ❖ Reduce thrust once descent established.
- ❖ Approaching horizon, complete the recovery, by rolling wings level, adjust speed, thrust and pitch.

### Nose-Low Recovery

Situation: Pitch attitude more than 10°, nose down. (Roll the wings level before adjusting pitch)

- ❖ Check speed - if increasing rapidly, reduce thrust and consider speedbrakes.
- ❖ If high bank angle; reduce the angle of attack (unload) with smooth push & roll wings level. (Prevents over stressing a/c).
- ❖ Apply stabilizer trim, if necessary, particularly in a steep descent with speeds above V<sub>mo</sub>/M<sub>mo</sub>.
- ❖ Wings level or nearly so, raise nose to recover without over stressing or stalling a/c.

### Other considerations

**Excessive use of pitch trim or rudder may aggravate the upset. Only small rudder inputs should be used. Rudder applied too quickly or held for too long may result in the loss of control or structural failure.**

- ❖ To obtain asymmetric thrust TAC must be OFF.
- ❖ ALTN trim levers move STAB directly, whilst trim switches change the trim reference speed.
- ❖ Only use rudder if the a/c is not stalled and roll control is non effective.
- ❖ Use any necessary force to unjam stuck controls.
- ❖ Damage assessment; use QRH 'Flight with Unreliable speed' for clues. Inspect cabin.
- ❖ Do not change config. Disconnect PFC as last resort.
- ❖ Inform ATC / Co. NITS.
- ❖ At a bank of more than 67°, level flight cannot be achieved without exceeding the flying manual limits of 2.5g load factor.

## Fuel

(A[1] 8.12.2 Jun 08)

### u Fuel Jettison

(QRH MAN-50-2 / QRH 12.6 Jun 09)

- ❖ Note the first checklist in the Fuel list is [ ]FUEL AUTO JETTISON. This is for a fuel jettison auto shutoff failure.
- ❖ Inform ATC.
- ❖ Min Alt 6000ft, (Except emergency).
- ❖ Avoid areas of PPN, static, lightning. Do not jettison in hold.
- ❖ Warn CSD/PAX.
- ❖ Jettison rate approx 2.5 tons/min, with fuel in CWT (QRH MAN-50-2 Mar 03)  
1.4 tons/min, with CWT empty
- ❖ Standpipe level approx 5200 kg/ main tank, total 10400 kg.
- ❖ Fuel to remain defaults to MLW. Jettison time displayed on synoptic.
- ❖ Philosophy: use any landing wt up to MLW. Don't spend time jettisoning when can get on ground sooner.
- ❖ Time, place & estimated quantity jettisoned must be reported in Tech log & ASR. (A[1] 8.12.2 Jan 11)
- ❖ Using lower rate of 1.4 tons/min, a/c will jettison 17600 kg in 12 min which is approx descent time from 35000 to 25000 in drift down. (Perf M. 8.0.08 Feb 01)
- ❖ Beware of selecting landing speeds if dumping not complete.
- ❖ Jettison will not sort out an imbalance. Jettison and Imbalance checklists can be run at the same time.
- ❖ Resetting Fuel Pump/Refuel Valves C/B's in flt prohibited. (FCom1 NP-10-16 Jun 09)
- ❖ Fuel should not be jettisoned for purely commercial reasons except with prior management approval. In cases of operational necessity Capt may dump fuel at his discretion. (A[1] 8.12.2 Jan 11)
- ❖ Indicated totaliser fuel is used to determine shut off point. If totaliser in error – time dump manually.
- ❖ As a matter of CRM, both pilots to independently work out the target fuel to remain.

#### Tech reminders.

- With Override/Jettison pumps from the centre tank switched off, fuel will not be jettisoned from the centre tank.
- Jettison nozzles cannot be opened on ground.
- Computed jettison time is displayed on the fuel synoptic.

### [ ] Fuel Imbalance

(QRH MAN-50-2 / QRH 12.4 Jun 09)

#### EICAS Caution Msg:

[ ] FUEL IMBALANCE

#### Condition:

Message appears when imbalance is between 1361—2041 kg (proportional to fuel qty and type) detected for 30secs. (3 Fleets Jul 04)

- ❖ Increasing imbalance or difference in Totaliser & Calculated fuel of 500 kgs in 30 mins – consider as eng fuel leak. Do uFUEL LEAK checklist.
- ❖ Only do FUEL IMBALANCE checklist when actual imbalance has been confirmed. (Comparison of fuel flows, eng fail or other evidence). This applies even after eng failure. Do not assume fuel imbalance is just due to the eng fail. Check PROG p2 and note the CALC & TOT values are within 0.5 kg. i.e. what's gone through the engine and what the FMC sees are roughly the same.
- ❖ A/C handling OK up to 7300 kgs imbalance. (QRH MAN-50-2 May 07)
- ❖ Note that the Fuel Balanced message appears on the expanded fuel indication, flashes for 5 secs.
- ❖ Fuel imbalance pointer points to LOW tank. Amber when [ ] FUEL IMBALANCE msg appears. Pointer is white when main tank differs by 500 kgs, or 100 kgs with X-Feed open. (TM[FC2] 10-4 Apr 03)
- ❖ Pointer flashes if going in wrong direction.
- ❖ The ECL asks for one X-Feed valve to be opened. Note that the ECL does not auto check this off. It's waiting for you to action & confirm the valve has opened before the booster pumps are switched off.
- ❖ If [ ] FUEL IMBALANCE msg appears on approach - can safely ignore till after G/A or on the grnd.
- ❖ Fuel balance required for long term structural reasons rather than flt control reasons. It is not recommended that fuel X-feed be opened immediately after engine shut down. In the real A/C fuel is pumped from the pump with the highest output pressure so fuel may come from tank with lowest qty if X-feed is open. (QRH MAN-50-1 May 07)
- ❖ Fuel balancing can continue to landing.

#### Tech reminders.

(3 Fleets Aug 04)

Fuel imbalance depends on fuel quantity and a/c type & condition lasting 30sec or more.

#### ZZA-ZZC

Difference between L & R Main tank of 1361 kg when total main tank fuel >50,348 kg

Difference between L & R Main tank of 2041 kg when total main tank fuel <20,412 kg

Linear interpolations between two limits.

#### Rest of fleet...

Difference between L & R Main tank of 1361 kg when total main tank fuel >51,709 kg

Difference between L & R Main tank of 2041 kg when total main tank fuel <22,680 kg

Linear interpolations between two limits.

**[ ] Fuel Qty Low**

(QRH MAN-50-1 / QRH 12.15 Jun 09)

**EICAS Caution Msg:****[ ] FUEL QTY LOW****Condition:**

Fuel Qty low in either main tank

**Indication:**

Low Fuel:-(

Check for Eng fuel leaks.

**Approach & Landing**

- ❖ Clean configuration should be maintained as long as possible during descent & approach to conserve fuel.
- ❖ To prevent fuel running forward in the tanks, initiate config changes early to give a smooth, slow deceleration.
- ❖ Use Flap 20 and VREF 20 for ldg. Gives improved control for ldg flare in event of dual eng flameout.
- ❖ Avoid high NU attitudes & excessive changes of speed to avoid uncovering all fuel pumps
- ❖ Avoid heavy braking and high levels of reverse thrust to avoid uncovering all fuel pumps & causing engine flameout during landing roll. (RWY conditions permitting).

**Go-Around**

- ❖ Apply thrust slowly and smoothly and maintain minimum nose up body attitude required for safe climb gradient.
- ❖ Avoid rapid acceleration of the aeroplane.
- ❖ If any wing tank fuel pump low pressure light illuminates, do not turn off fuel pump switches.

**Fuel Leak**

(QRH 12.8 Jun 09)

**Condition:**

Fuel leak suspected

**Objective:**

Check for fuel leak and shut down eng as appropriate.

- ❖ Increase in fuel imbalance of approx 500Kg in 30 mins considered a fuel leak.

**Tech**

(TM[FC2] 11-42-47 Jun 09)

After fuel jettison or all eng shut down CALCULATED fuel resets to totaliser system qty.

GE eng

- ❖ CALCULATED fuel decreased by fuel flow sensors with a tolerance of up to 40kg/hr variation in CALCULATED fuel.

RR Eng

- ❖ CALCULATED fuel decreased by fuel flow sensors with a tolerance of up to 73kg/hr variation in CALCULATED fuel.

**Fuel Contamination**

(747 Loft Exercise Jun 97)

- ❖ Engs will gravity feed, even if pumps are stopped. (Pumps are designed this way). However, if contaminated with water, & its very cold, water will freeze and block exit from tank. Therefore, pumps are required to stop this & keep fuel flowing.
- ❖ Water takes ≈ 40 mins to separate & sink to bottom of tank. Try waggling wings to keep it stirred up.
- ❖ Dumping + fuel used will eventually get rid of it, (assuming its water).
- ❖ Need AIR, FUEL, IGNITION.

## Hydraulics

(TM[FC2] 13-20-1 Apr 03)

### Hyd Technical

Hydraulic services				
	L	C1	C2	R
Primary --->	EDP	ELEC	ELEC	EDP
Demand --->	ELEC	AIR	AIR RAT	ELEC
	Flt Cntrl        L Reverse	Flt Cntrl Steering Nose gear Main gear (use altn) Flaps (use altn) Altn/Reserve Brakes		Flt Cntrl       Normal Brakes (Auto brakes) R Reverse

### RAT deploys when:—

- ❖ Both eng fail + C Press Low
- ❖ Both AC transfer busses unpowered,
- ❖ All 3 hyd Press Low:

**HYD PRESS SYS L+C+R**

### Autoland

Lose one system: **LAND 2**Lose two systems: **NO AUTOLAND** A/P OK for normal flying

## Single Hyd System Inop

(QRH MAN-39-1 / QRH 13.3 / 13.6 / 13.12 May 07)

EICAS Msg:

[ ] HYD PRESS SYS C

(QRH 13.3 Mar 09)

### Overview

#### The centre system powers:

- Flight controls
- Slats
- Flaps
- Landing gear actuation
- Alternate brakes
- Reserve brakes
- Nose gear steering
- Main gear steering

#### Implications of loss of system:

some loss of roll rate, no Auto speedbrake - manual s/brake  
 use secondary slats (electric & slower), use normal flap lever  
 use secondary flaps (electric & slower), use normal flap lever  
 use alternate gear (no retraction once down)  
 Normal brakes are available (inc A/Brake)  
 should be available (accumulator brake also available)  
 should be available  
 lost, (reduced manoeuvrability on ground / tyre scrubbing).

### Handling Notes

- Items inop:–
  - Main gear hyd ops
  - Main gear steering
  - Flt Controls: 6 out of 14 spoilers lost. Doesn't feel much different.
  - Use man speedbrake on ldg. (Check Performance manual for ldg wt changes).
- Brief for FULL reverse. (Easy to forget reverse if you have man speedbrake!!) *(Perf M. 4-1-3 Feb 97)*
- Use Flaps 20 & Vref20 for landing, (increases control response on finals & ensures adequate G/A performance due to slower slat/flap movement in secondary mode).  
 In FMC ensure have 'Flap20/ speed'. This signals ECL for a flap 20 ldg.
- NITS briefing.
- Secondary system operates automatically. Use normal flap selections.
- When F1 selected get the **SLATS PRIMARY FAIL** eicas msg. Also **NO LAND 3** eicas msg. LAND 2 annunciation.
- When F5 selected get the **FLAPS PRIMARY FAIL** eicas msg.
- Secondary flap (electric) takes time, (use stopwatches),
 

• Flap 0 to 1	2 min	Max F1 speed 240/255
• F1 to F5	2 min	Max F5 speed 220/235
• F5 to F20	1 min	
- Note: this is deferred to the approach checks, which happens when cleared to an altitude. (Transition Alt is?)
- Since flap extension takes longer, it is recommended to keep the airspeed as it is until the desired flap setting is reached - otherwise you can be flying too slowly for the current configuration, especially if distracted.
- Think time management. Want to land asap. Is holding until configured to F20/ Gear down a good idea?
- Alternate gear extension. (Extend prior to entering traffic pattern and avoid icing if possible. Check WXR before extending as cannot retract. Might require < 240kts to lock gear down).
- Nose gear may come down at same time as Main gear lever selected. This may indicate have nosewheel steering as hydraulics to nose are OK.
- Flare forces are higher due loss of elevators. Do NOT float.
- May required tow in, as nose gear steering may not work.
- Auto land OK – but LAND 2 annunciated – Cat 3A limits.
- Check landing distance. (QRH). *(QRH PI-11-1 / PI-21-1 / PI-41-1 May 07)*
- Once gear down, committed to land. Get ldg clearance before selecting gear. Advise ATC, PAN call at least.
- When taxiing with **HYD QTY LOW C** or with C primary pump only in operation, nose wheel steering may be slow to react. Excessive force on tiller may cause abrupt tiller movement in opposite dirn. *(QRH MAN-39-1 May 07)*
- This is the worse Hyd system to lose.

### Tech Notes

*(TM[FC2] 09-20-18 Apr 03)*

- Alternate gear actuation.  
 The nose gear should extend normally as the centre hydraulic isolation system (CHIS) maintains pressure in that part of the system. If it doesn't, nose gear steering may not be available. Main gear is extended using a dedicated alternate power pack. The battery powers a 28v DC hydraulic pump with an isolated standpipe supply of hydraulic fluid, replenished by the centre reservoir. When the Altn gear switch is pushed the pressurised fluid extends 3 pairs of actuators that release each landing gear door and then unlock each gear. The landing gear will then extend due to their own weight and airloads. This takes about 25 secs. Once extended, the gear cannot be raised.
- Nose Gear.  
 CHIS will, through closure initially of both isolation valves, isolate the nose gear actuation and steering as well as the reserve brakes; reserve brakes remain operable while initially the nose gear is isolated without system pressure. When the fluid level in the reservoir drops to 'reserve' level, CHIS determines that the leak is on the main system side and reopens the left isolation valve and pressure is provided to the nose gear; QRH action results in the C1 primary pump being left on for this purpose.

**QRH***(QRH 13.3 Mar 09 / Alan Stewart)*

- C2 primary, C1 & C2 demand OFF. By implication C1 PRIMARY ON! This is the source of pressure through CHIS for nose gear and reserve brakes. Make sure you don't switch it off.
- GPWS > OVRD... in preparation for Flap20 approach.
- G-ZZZA-C: Slats extend beyond midrange when < 215kts  
G-RAES-G-YMMU: Slats extend beyond midrange when < 239kts
- Slats remain sealed (midrange) above 215/239kts. A bit of a red herring. Slats are normally sealed until F25 or 30 anyway. In secondary mode the slats are gapped at all settings to improve stall characteristics since autoslats are not available. The exception is if the failure occurs when they are already at the mid range. If 215/239 is exceeded with any secondary flap setting then slat LOAD RELIEF will occur and the slats will retract to the midrange anyway. No big deal!
- Flaps20 for landing...to cover the go-around (slow flap retraction). Check ldg dist.
- Speedbrake.. brief for manual spoilers on touchdown, then full reverse. S/brakes less effective.
- Do not arm Speedbrakes to prevent inadvertent inflight extension.
- Flap selection is deferred to the approach checklist. This is not actioned until QNH is set. Allow time and distance out for this. When they are selected expect the associated EICAS messages. Delay selecting the next manoeuvre speed until that flap setting is achieved.  
USE THE NORMAL FLAP LEVERS. Not the Altn flap system (a common mistake).
- After selecting the gear lever down... delay the Altn Gear Switch until have checked for pressure to the nose gear & thus nose gear steering.
- Autopilot and Autoland (Land 2) are available. Note: Autoland lands deep (50ft flare height).
- Autobrake is available... check landing distance – use the autobrake setting chart.
- Manual speed brake after ldg.
- Checklist protracted as all the notes are repeated on the approach checklist.

**Go Around Brief**

- Flaps stay at F20. What are you going to call? (G/A flap is not mentioned in QRH. So do not move!).
- Do not select gear up. (Cannot raise gear if extended on Altn system).
- Consider cleaning up to F5 only, due to extra time to move flaps, up then down...
- Do not exceed 215kts (ZZA-C) or 239kts (rest of fleet) until slats retract to midrange.
- Do not exceed 270kts/M0.82 gear extend limit speed.
- For gear down diversion, FMC does not take into account performance penalties.

*(QRH PI-14-1 / PI-24-1 / PI-46-1 May 07 et seq)***Think**

- Any possible cause for the failure? Any significant ADD's to affect situation?
- Is a second hydraulic failure likely? Implications? (land at nearest suitable airport)?
- X-wind limits?
- Auto Flight?
- Stab position?
- Control response?
- Reverse handling?
- Stopping distance?
- G/A?

## Dual Hydraulic Failures (also see notes above)

- ❖ PAN call. Land at nearest suitable.
- ❖ Flight controls now suffer a noticeable degradation.
- ❖ Calculate landing distance. (QRH). (QRH PI-12-4 / PI-22-4 / PI-42-4 Jan 09)
- ❖ No Auto land, but A/P available to 200 agl. (NO LAND 3 recall).
- ❖ Use Flaps 20 & Vref30 + 20 for landing. (Used for multiple hyd failures to improve flare authority, control response & G/A). i.e. the normal F20 manoeuvre speed (10kts > Vref20).
- ❖ Max X-Wind 20kts.

### [ ] HYD PRESS SYS R+C

(QRH 13.14 May 07)

Items inop:–

- Stabiliser
- Main gear hyd ops.
- Main gear steering
- Flaps via hydraulics
- R Thrust reverser, (do not land on slippery RWY)
- Normal & Altn brakes. Reserve OK
- Autobrakes (only works with normal brakes).
- STAB CUTOFF switches are CUTOFF. Prevents **STABILIZER** msg.
- Pitch trim is still available by means of the PFCs changing the trim reference speed and positioning the elevators to trim the a/c. Nose down pitch authority is limited. Do not exceed current speed.
- NITS briefing.
- Right flaperon u/s – approx. 2 divisions of left aileron trim required
- Secondary flap (electric) takes time, (use stopwatches),
  - Flap 0 to 1            2 min
  - F1 to F5             2 min
  - F5 to F20            1 min
- Note: this is deferred to the approach checks, which happen when cleared to an altitude. (Transition Alt is?)
- Alternate gear extension. (Extend prior to entering traffic pattern and avoid icing if possible. Check WXR before extending as cannot retract. Might require < 240kts to lock gear down).
- Normal brakes lost, inc Autobrake. Reserve brakes should be available via CHIS (Cntr Hyd Isol Sys). If **BRAKE SOURCE** is displayed, only accumulator braking available – use a smooth, steady application.
- On approach temporarily disconnect AP, trim out aileron displacement (flaperon) and re-engage AP. Now, when AP is finally disconnected for landing, the aeroplane should be in trim.
- Flare forces are higher due loss of elevators.
- Do not allow a/c to float.
- Use man Spd Brake on Idg and full reverse on L eng, manual brakes.
- May required tow in as nose gear steering may not work.

### Go Around

- Flaps stay at 20 for G/A (no mention in QRH so they are not moved!).
- Cannot raise gear if extended on Altn system.
- Do not exceed 215kts (ZZA–E) or 239kts (rest of fleet) until slats retract to midrange.
- Do not exceed 270kts gear extend limit speed.
- For gear down diversion, FMC does not take into account performance penalties. (QRH PI-14-4 Sep 03 et seq)



## Incapacitation / Medical Emergencies

(FCOA 18 – Oct 02 &amp; QRH MAN-32-1 May 07)

<b>Recognition</b>	No response to ANY verbal comms regarding procedural deviation, OR No response to two verbal communications.	
<b>Assume control</b>	“I have control”	
<b>Ensure safe control of A/C Engage A/P, A/T</b>	<b>Check FMA's.</b> Ensure safety of A/C, (G/A if necessary, except if late stages of a low vis approach – Don't forget to clean up A/C if in a G/A etc.!!!!)	
<b>Secure incapacitated pilot</b>	Move seat fully aft & remove pilot if possible, otherwise, fit & lock full harness. Rudder pedals fwd. Secure hands behind harness.	
<b>“SCCM to F/D”</b>	NITS – Arrange medical team, MEDLINK or Dr on board? Postec on board? (But see A[1] 6.1 Jun 08 i.e. fit for duty!). MEDLINK on SAT phone or .PHXMACR or 001 602 239 3627.	
<b>Plan Ahead</b>	Unless in critical phase of flt, plan ahead before calling ATC.	
<b>“PAN” call</b>	Required if below min crew compliment or for any medical emergency	(A[1] 6.15.6 Jun 08)
<b>“MAYDAY”</b>	If crew unconscious & little or no vital signs. “Seriously ill – life threatening emergency/condition”	
<b>Diversion...??</b>	Consider: Further crew incapacitation? Diversion A/F (familiarity, WXR, difficulty of A/F), Condition of incapacitated pilot & medical facilities available, Reduction if flt time if divert (extended single pilot ops should be avoided) Other relevant issues (seniority etc.)	(FCOA 19/06)
<b>Prior to Ldg</b>	Brief cabin crew to keep pax in seats. Arrange medical attention for crew member on ldg. Arrange marshalling if parking from the RH seat.	(A[1] 6.15.6 Jun 08)
<b>After Ldg</b>	After ldg checks - stop A/C if necessary. Doors to Manual!!!!!!	
❖ Make full use of automatics, use A/Land, (except if CAT B RWY).		
❖ If incapacity for no obvious reason - flt crew to don O2 mask.		(A[2] 4.18.2 Jul 09)
❖ Partially incapacitated pilot not to participate in further operation of a/c.		
❖ If incapacitated pilot remains on F/D, use crew O2 on NORMAL until portable bottle can be substituted.		(A[2] 4.18.2 Jul 09)
❖ Cabin crew member to be on F/D to act a 'gofer'. Not to sit in pilots seat.		
❖ Consider actions for locking/unlocking flt deck door, and taking a 'physiological' break.		
❖ Incapacity after TOD, on CAT 3 A/C, with WXR below CAT 1, considered safer to continue, otherwise consider diversion to A/F with CAT 1 conditions.		(A[2] 4.18.2 Jul 09)
❖ Re-read Descent Briefing to check for any relevant changes, i.e. X-wind, A/F cat etc.		
❖ Ensure altimeters are set on both sides, especially Capt.'s instrument. (Avoids problems with EGPWS/pressurisation, altitude exceedances).		
❖ In Cat 3 conditions, with no response to DECIDE, F/O completes landing (rather than G/A).		(A[1] 8.3.18.15.10 Jun 08)
❖ If landing on class B or un-categorized RWY – manual landing.		
❖ Taxi to stand. Dual tiller fitted? Parking guidance? – marshalling required? If so – make the request early. A medical emergency may require you to taxi to a special stand.		
❖ Do not allow the After Landing Checks to distract handling pilot.		
❖ After the final stop, start APU and set doors to manual.		
❖ Complete BA Accident Report Form P 413(4) & ASR.		
❖ Crew member to see BAHS Dr ASAP after ldg.		(A[2] 4.18.3 Jul 09)
❖ Taxi problems for P2 parking?		
❖ P2 to sign tech log if Capt incapacitated, and File ASR.		(FCOA 18 Oct 02)

### Ambulance @ LHR

(Speedbird 06 Jun 01)

At LHR declare PAN (not a medical emergency) to have an ambulance meet your aircraft on arrival.

After declaring an emergency to ATC, call Airport Centre/Terminal Control as it is they who call the Ambulance services. London

Ambulance Service require - patient's name, gender, age, symptoms, special req e.g. O2.

(A[1] 6.15.6 Jun 08, FleetNews Sep 01)

Any internal '222' emergency call routes via the BAA control centre to the London Ambulance Service.

(777 ConcNews Feb 02)

Keep PAX seated until injured have been removed.

## Landing Gear/Brakes

### Gear Disagree

(QRH MAN-39-1 May 07 / QRH 14.3 May 07)

#### EICAS Msg:

[ ] GEAR DISAGREE

#### Ldg Gear Lever UP

- Observe extend limit 270kt/M0.82
- Increased fuel consumption with gear down – refer to QRH performance tables. FMC does not detect this (requires switch in electrics bay).

#### Ldg Gear Lever DOWN

- Observe extend limit 270kt/M0.82
- Gear problem likely to manifest itself on approach. If G/A carried out – do not retract the gear with the “Positive Climb” call. Put a piece of paper over the gear lever as reminder.
  - After G/A, **GEAR DISAGREE QRH**
  - then **“EMERGENCY LANDING**
- Use Altn Gear switch. Wait 30 secs, and speed below 240kts to lock gear down.

### Altn Gear Extension/Partial Gear Ldg

(QRH MAN-39-1 May 07/ QRH 14.3 Sep 03)

#### Altn Landing Gear Extension

(TM[FC2] 14-20-02 Oct 99)

- Selecting DOWN on the ALTN GEAR switch releases all the door & gear uplocks. A dedicated DC hyd pump in the C hyd system release the uplocks. The gear free falls to the locked posn. The ldg gear lever has no effect on the Altn extension.
- EICAS displays the expanded gear indication. The EICAS msg **GEAR DOOR** is also displayed because the hyd gear doors remain open.
- Following Altn extension, the gear can be retracted by the normal system if it's operational. Select DN then UP to retract gear normally.
- Alternate Gear extension may require <240kts. This may need flap 1.

#### Partial Gear Ldg

(QRH MAN-39-2 May 07)

- NITS. Emergency ldg brief to PAX. Co-ordinate with ATC & ground facilities.
- Reduce wt as much as poss to reduce touchdown speed. Refer to Min Ldg dist in QRH.
- Foaming of RWY not recommended, although Capt can elect to use if there is NO DELAY to landing. (A[1] 8.11.8 Jun 08)
- A fly past of the tower not recommended.
- Use gear override switch – avoids nuisance warnings.
- Extend all available gear. At circuit height, depressurise A/C. All fuel pumps off (reduce fire risks).
- Use normal approach, flaps 30.
- Keep to paved surfaces. (Land on side of extended gear).
- Manual speed brakes.
- Land on all available wheels. (See QRH MAN-39-2 for details). Belly landings not recommended, due increased fire risk.
- Initiate emergency evacuation.

### u Gear Lever Locked Down

(QRH 14.5 Jun 09)

- ❖ A/C performance almost similar to eng out performance. Consider emergency turn and inform ATC of any turn.
- ❖ Do not move gear lever up until checklist dictates.
- ❖ Manually override.

### General Gear Considerations

- ❖ Tyre pressures on one or more bogies may be zero. Check landing distances, higher auto brake setting.
- ❖ NITS briefing to SCCM. Ask them for any evidence of burst tire (noise).
- ❖ Report any tyre burst or similar damage to ATC. (A[1] 8.12.4 Jan 10)
- ❖ FUEL JETTISON checklist.
- ❖ Declare PAN.
- ❖ May have steering difficulties.
- ❖ Whenever wheel/tyre overheating/damage is suspected ATC must be alerted to request emergency services to inspect wheels & deal with possible fires. (A[1] 8.12.3 Jan 10)
- ❖ Fire service will not inspect until all engines shut down, unless you can get a BA engineer out to do the inspection.
- ❖ Stay on RWY till gear pins installed and gear has been inspected. Do not taxi or tow until this is done.
- ❖ When any wheel leaves paved area, wheels/tyres must be inspected before next T/O. Undercarriage assembly must be assessed.
- ❖ Select gear down normally – wait 2 secs before selecting ALTN gear. If nose gear comes down – highly likely have nose gear steering due to fact hyd still pressurised. (A Stewart)
- ❖ Foam carpets are not recommended, but can use it if offered with no delay. (A[1] 8.11.8 Jan 10)
- ❖ Capt to make an PA as soon as practicable if evac not required, “Pax & crew remain seated & await further instructions”.

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**Landing on Flat Tyre**(QRH MAN-39-1 May 07)

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- ❖ Use normal approach and ldg techniques.
- ❖ Use differential braking as required to help with directional control.
- ❖ With a single tyre failure, towing is not necessary unless there is unusual vibration or other failures.
- ❖ Flat main gear tyre(s) cause a general loss of braking effectiveness and a yawing moment toward a flat tyre with light or no braking and a yawing moment away from a flat tyre if the brakes are applied harder.
- ❖ Maximum use of reverse thrust is recommended.
- ❖ Do not use autobrakes.
- ❖ If a nose tyre has failed, slowly and gently lower the nose wheel to the runway. Differential braking may be required to help steering. Use idle or higher reverse thrust as required to stop.

## Navigation

### Double FMC Failures

(TM[FC2] 11-50-02 et seq Apr 03)

#### EICAS Msg:

**FMC L/R** – Affected FMC failed.

(QRH 11.1 May 07)

**FMC** – Both FMC's failed, or FMC selector in L/R with L/R FMC failed.**AUTOPILOT**

- ❖ LNAV/VNAV fail, FMA will show if A/P engaged. If manual, expect F/D's to be removed. In this case get the A/P in, with HDG SEL and V/S or FLCH.
- ❖ VNAV is lost (VTK appears on ND), but LNAV can be re-engaged, cycle through HDG HOLD or SEL.
- ❖ A/T may be lost. If available can be used. Add 20kt increments to Vref30 for retraction/extension. Or use V2 if available (e.g. after T/O >400R). Manoeuvre speed disappear from PFD speed tape.
- ❖ Pages available on each CDU:
  - \* ALTN NAV LEGS } No ETA's given
  - \* ALTN NAV PROG (page 1 only) } but TTG avail.
  - \* ALTN NAV RADIO } L FMC tunes L & C ILS: R FMC tunes R ILS.
- ❖ Positions must be entered as Lat/Long. e.g. 7 fig (N50W080) or 15 fig.
- ❖ No Auto tune/ident; manually tune all aids as a frequency, (No Nav Base) & ident aurally. Use APP or VOR for NPA using raw nav info. An ILS DME only available when APP selected on ND.
- ❖ Manually set Landing Altitude as destination A/F is lost, **LANDING ALT** msg displayed.
- ❖ Active track is referenced to Mag or True if req, the rest are referenced to True, (ADIRU supplies mag var for present posn).
- ❖ Wind read outs on ND are lost.
- ❖ No fuel projections on LEGS/PROGRESS page. Fuel monitoring on CIRRUS v EICAS indication.
- ❖ No prompt by altimeters for transition.
- ❖ Target N1's (or EPR's) are removed. Use QRH. (Write down & display with Vref & manoeuvre speeds).
- ❖ Vref & performance info from manuals. Set Vref on STBY ASI. (Note the G/A N1 if A/T manual).
- ❖

#### After T/O

- LNAV/VNAV engaged – Manual flt – F/D bars are removed.  
– A/P in – **AUTOPILOT** EICAS msg – engage HDG SEL and V/S or FLCH.
- Flap retraction & clean manoeuvre speeds removed. Add 20kts increments to Vref30 or V2 speed.

#### Notes

- A/P selects CDU in order: L CDU; C CDU; R CDU. CDU uses ADIRU for position data.
- CDU's supply nav data to ND's, & one of the CDU's supplies LNAV guidance.
- CDU does not store: Conditional Waypoints, Offsets & holding patterns, hence lose G/A route.  
Many of the arrival waypoints are lost; hence a series of route discontinuities.
- FMS-CDU memory is temporary - any deleted or used waypoints will have to be reloaded as lat/ long.
- ND only shows short version of Lat/Long of entered waypoints.
- Information entered into 1 CDU is transferred to the other when executed.
- CAT 3 A/Land available. (Note that a **LAND 2** annunciation is a clue that not all 3 ILS's are tuned).
- Note: L RADNAV page shows the L radios on the L of CDU screen.  
R RADNAV page shows the R radios but still on the L of CDU screen.
- If ND goes blank – cycle the CDU switch. (It should auto switch).
- MNPS see limitation section.

**[ ] NAV ADIRU INERTIAL**

(QRH 11.3 Jan 09)

**EICAS Msg:****[ ] NAV ADIRU INERTIAL**

ADIRU is not capable of providing valid attitude, position, heading, track, and ground speed.

- ❖ On ADIRU failure, the ND MAP display blanks momentarily and then reboots into TRACK UP mode.
- ❖ GPS continues to provide position and track information.
- ❖ Navaid auto-tuning is still available.
- ❖ Heading information is displayed for 3 minutes after the NAV ADIRU INERTIAL message is displayed. If the aeroplane is in the polar region, heading information is removed immediately.
- ❖ Amber lines are displayed on the FMA. Note that LNAV, TRK SEL & VNAV are all u/s so use the basic modes of HDG SEL, ALT HOLD, FLCH, & V/S.
- ❖ A/P & A/T are still available.
- ❖ Auto brake is u/s.
- ❖ Other messages that appear are **WINDSHEAR SYS** **[ ] GND PROX SYS** & ALTITUDE CALLOUTS.
- ❖ Approach phase. LOC/GS/FPA are not available. Use HDG SEL & V/S to CAT 1 minima.
- ❖ During a G/A, the FMA displays THR/TOGA/TOGA, which after a few seconds changes to remind you to select HDG SEL.
- ❖ Inoperative items:
  - \* FMC VNAV pages
  - \* FMC performance predictions
  - \* PFD flap manoeuvring speeds; refer to Flap Manoeuvring Speed table.
  - \* ND wind direction/speed and wind arrow
  - \* Autobrake.
- ❖ Inoperative AFDS modes:
  - \* LNAV
  - \* VNAV
  - \* TO/GA
  - \* LOC
  - \* GS
  - \* FPA
  - \* TRK HOLD/SEL.
- ❖ Periodically cross check heading for drift with the magnetic compass and update SAARU heading as necessary. If magnetic compass information is unreliable, use track information.
- ❖ VOR course deviation is available in the ND VOR mode. ILS LOC and G/S raw data is available on both the PFD and the ND.

## Pneumatics (Air Systems)

(TM[FC2] 02-20-1 Apr 03 / QRH MAN-40-1 May 07)

### [ ] Cabin Altitude (Emergency Descent)

(QRH 2.1 / QRH MAN-40-2 Mar 08)

**Indication:** Pressurisation popup on EICAS followed by **[ ] CABIN ALTITUDE** (red), MW, & siren.  
(Crew rest: Horn + Lts illuminated)

	HP .....	NHP
	<< -----	O2 MASKS ON ----- >>
	<< -----	Establish Comms / 100% selected ----- >>
	CABIN ALTITUDE & RATE --- CHECK	
	}	..... Ensure Bleeds ON / Packs ON
	}	..... Sys Fault Lts Check
Monitor	}	..... Outflow valves closed
	}	..... Adding thrust might do the trick!
If Out of Control: ..... PAX OXYGEN - ON (Confirm on EICAS)		
DESCENT ACCOMPLISH (with A/P)		
❖ 1st Pass	<ul style="list-style-type: none"> <li>• Set MCP Altitude to any lower level</li> <li>• FLCH</li> <li>• Extend Speed brakes.</li> <li>• Set IAS to MMo/VMo: ensure HOLD is annunciated. (Maintain current or slower speed if structural problems suspected)</li> <li>• Hdg SEL (if required — especially on NAT track — don't want a TCAS CLIMB!)</li> </ul>	
❖ 2nd pass	<ul style="list-style-type: none"> <li>• Set MCP Altitude to highest of MSA or 15,000 (10,000 if not fuel critical)</li> <li>• Refine IAS as required.</li> </ul>	
❖	Approaching level off, prior to ALT capture – set 310 kts & when decelerating, stow S/Brakes smoothly	
❖	Level off – set LRC	

- ❖ Inform ATC.
- ❖ Squawk 7700 if no ATC contact.
- ❖ Mayday on 121.5 if on HF.
- ❖ Re-check MCP Alt is safe.
- ❖ QRH.
- ❖ Level off at MSA or 15,000ft (10,000ft if fuel endurance is not critical),
- ❖ Level off at or below 15,000ft & when conditions permit:  
“DESCENT IS NOW COMPLETE, SCCM REPORT TO FLIGHT DECK”  
SCCM reports to Flt Deck (with portable O2 on).

#### Descent Accomplish

- Strict intercom procedures. Be formal, “Capt to F/O”.
- After establishing comms, – ensure someone has control,
- Descend with gear UP and autopilot engaged.
- Clue is the OUTFLOW valve. They should be shut. If shut manually, need to return to AUTO when levelling off for correct control of pressurisation. (It is now not recommended to close the valve manually - Ed) *(Al Stewart)*
- If structural integrity in doubt, limit airspeed at or below speed at time of decompression. Avoid high manoeuvring loads.
- N.B. Barbers pole increases in speed during the descent, until ≈ 23000ft then it decreases in speed.

Call for “**EMERGENCY DESCENT** checklist”. Ensure checklist is displayed.

MAYDAY to ATC or 121.5 if on HF.

Squawk 7700 (if no ATC contact.)

Check local QNH for MSA. (Where from? Sondestrom?).

Remember temperature correction of 4% Ht / 10°C < ISA.

Re-check MSA. Keep within 20nm of CIRRUS (MSA purposes) except over Ocean.

When cabin altitude stabilised above 10,000 – select crew O2 to NORM to conserve supplies.

- Turning off course – consider ROUTE OFFSET. (In Canada: only turn to Right!)
- If using HF, make first call on 121.5.
- NHP should call 2000ft & 1000ft above level off alt.
- Ensure speed decelerating before stowing speed brakes.

(200 FTM[FC2] 13-04-18 Dec 90)

(200 FTM[FC2] 03-01-36)

**Follow Up Actions**

(QRH MAN-40-3 May 07)

- When descent is complete, ensure F/O has control & is briefed.
- What went wrong? Can we fix it?
- How long have we got? O2 duration, fuel situation, WXR, nearest airport.
- New ATC clearance.
- Brief Cabin Manager:–
  - NITS:
    - N – Pressurisation problem – all now secure
    - I – Divert to XYZ
    - T – Time to divert, or dump as required
    - S – Structural problems – get crew to check
      - List of injured PAX/Crew
      - Cabin below 15,000, able bodied persons can come off O2
      - Expect NORMAL / EMERGENCY ldg.
      - I will speak to the PAX after you have briefed crew.
- DUMP only when assured of ALTN.
- When crew O2 no longer req – close stowage left hand door, press reset/test btn. (Cuts O2 and reconnects boom mike).
- If further O2 required, open stowage left hand door,

**Premeditated Descent**

If pressurisation clearly giving problems – prepare for a POSSIBLE descent:

- Get NHP on O2 & hand over control
- PAX signs ON *Sit on hands until*
- Warn ATC *out of control.*
- Check MSA
- Switch on TERR mapping
- Advise Cabin Manager that LLAR area (if fitted) should not be occupied <FL250. (FCN 05/01)

**Notes**

- Make every effort to control cabin altitude and avoid emergency descent, although there is little you can do. (Need a positive reason for full descent, as once committed, you will probably not make it to destination).
- If you haven't started the descent after 80 secs from the decompression and made no PA, expect SCCM to enter the flight deck using the emergency entry procedure. (A[2] 4.18.2 Jun 08)
- Cirrus MSA bandwidth is 20nm, but in some critical circumstances may be 5 or 10nm. (FCOA 13 Jan 02)
- Descend below 15,000 to 10,000 if safe and immediate landing is planned. 15,000ft MSA is used for range considerations.
  - At 15,000 range is reduced by approx 30%?
  - At 10,000 range is reduced by approx 40%?
- Note: ETOPS critical fuel based on cruise at 15000ft.
- All crew must use O2 continuously while cabin alt exceeds 10,000ft. (A[1] 3.3 Jun 08)
- NHP should call 2000ft & 1000ft above level off alt.
- Expect toilet smoke detectors to activate due to misting from the drop in pressure (A[2] 4.19.1 Jul 09)
- Problem talking to the Cabin Manager on full face mask.
  - Soln: Either use speaker & I/C & ask Cabin Manager to put thumb up if they understand or use intercom with Cabin Manager outside). (JC)
- No smoking signs on.
- Ear problems, may get 'leans', trust instruments.
- Flt crew set O2 to NORM to conserve supplies. (QRH MAN-40-3 Mar 08)
- When O2 no longer required (Cabin Altitude  $\leq$  10,000ft), remove mask - Close LH door & press 'RESET/TEST' to turn off O2 & reactivate boom mike. Re-establish comms.
- During extended flight, check O2 not required by PAX is turned OFF.
- Do not re-stow crew or pax masks (done by engineering).
- How do you deal with your specs?
- Arrange medical examinations for PAX & crew on arrival. (QRH MAN-40-3 Mar 08)

**Crew Rest**

- O2 masks drop automatically.
- Warning horn sounds. Decompression Warning signs illuminate.
- Remain in bunks/seats until "The descent is now complete, will the SCCM report to the Flight Deck" call is made. Transfer to portable O2 and return to the flt deck.
- Do not re-stow masks.
- For OHAR 777-200s: chemical O2 last 22 mins. (SEP 10-46-11 Nov 10 / OPN 16/11)

## Tech Notes

- EICAS auto popup for Cabin Alt and Duct Pressure when:
  - Cabin in Caution range 8500 – 10,000ft (amber)
  - Cabin above Warning level 10,000ft (red and siren)
  - Duct press or differential pressure excessive
  - Outflow valve in manual
  - Ldg Alt selector pulled.
- Msg no longer displayed and siren silent when cabin descends below 9500ft (can also silence siren by pushing Master Warn button).
- Landing altitude derives from FMC: Departure A/F until + 400nm or half way whichever earlier, then switches to Destination A/F.
- ETOPS critical fuel assumes single eng de-pressurised cruise @ 15,000ft
- Cabin altitude of approx 13,500ft – O2 masks drop out automatically. *(TM[FC2] 01-40-11 Apr 03)*
- O2 duration based on ANO assumptions of: *(QRH MAN-40-2 Mar 08)*
  - All pax need O2 above 15,000ft
  - 30% pax need O2 between 12,000 and 15,000ft
  - 10% pax need O2 between 10,000 and 12,000ft
- < FL140 & if SMOKE present do not use PAX O2. PAX masks do not prevent smoke inhalation.
- O2 will flow until reset at PSU or the PAX EMERGENCY O2 switch is RESET.
- O2 tables assume that cabin crew will shut down 85% of masks within 11 mins of descending below FL150. Hence the requirement for “The descent is now complete”.
- Fasten S/Belt signs (AUTO) come on if Cabin Alt > 10,000ft. *(TM[FC2] 01-40-05 Apr 03)*
- For MSA's giving flt above FL150 – O2 duration varies with altitude – ball park duration of 50–100 mins between FL150 & FL 200. (For all 300 PAX, 1400psi). *(QRH PI-10-7 / PI-20-7 / PI-40-7 Jan 09)*  
Crew O2 not a factor in this situation as PAX is more critical.  
(For other situations e.g. SMOKE: then 2 crew, 100% demand, 1400psi, duration = 50 mins).
- A mask set to EMERG, but not donned will empty crew O2 in 70min.
- PAX O2 needs resetting before landing due fire risk. Not in the checklist. *(Al Stewart)*

## Useful times of consciousness

*(RAF Medical Notes)*

Altitude	Mod Activity	Sitting Quietly
22000	5 min	10 min
25000	2 min	3 min
30000	45 Secs	1¼
35000	30 Secs	45 Secs
40000	18 Secs	30 Secs

## Oxy Mask Details

*(TM[FC2] 01-30-25 Apr 03)*

- Release levers (Red).
  - Squeeze and pull to release mask from stowage.
  - Opening doors (LH) turns on O2 and the mask microphone.
  - Harness inflates when R button squeezed, yellow cross shows momentarily as it inflates.
- RESET/TEST lever (Push)
  - Mask stowed - tests regulator.
  - Mask not stowed and LH door closed - turns off O2 and deactivates mask microphone.
- Normal/100% Selector (red) Preflight set to 100%.
  - Normal = air/O2 mix on demand, ratio depends on cabin alt.
  - 100% = pure O2 on demand.
- Emergency/Test Selector (red) Preflight set to OFF, anticlockwise.
  - Push - tests positive +ve supply to regulator. Use for momentary smoke clearance /demisting.
  - Rotate to 100% - O2 supplied under positive pressure at all cabin altitudes.
- EICAS advisory msg **CREW OXY LOW** if crew O2 low.
- Donning mask. In smoke/dark, need to know where headset is – put on shoulders, then put on mask. Then goggles as necessary, then headset. Do not leave i/com on when not required, in case someone needs speaker (lost headphones in panic/smoke).
- Speaker needs to be ON!!!
- Restoring boom mike ops: Close LH O2 compartment door, & push RESET/TEST lever *(FCom1 SP-1-2 Oct 08)*

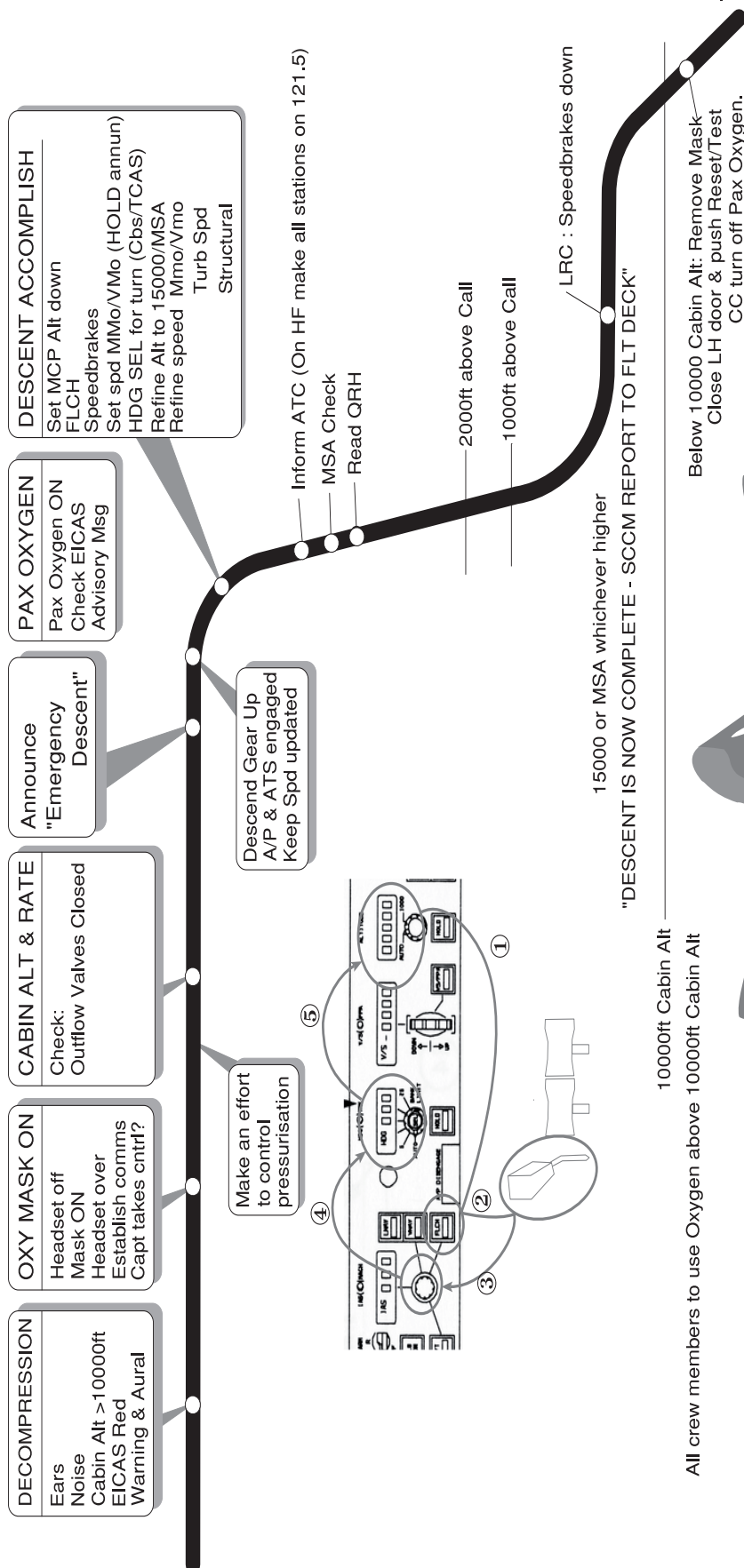
Loss of Crew O2 Sys

*(FCom1 SP-1-2 Oct 08)*



# 777 Emergency Descent

## Msg: Cabin Attitude



## Warnings

### [ ] Door XX

(QRH 1.1 to 1.4 Jun 09)

#### EICAS Msg:

[ ] DOOR AFT CARGO  
 [ ] DOOR BULK CARGO  
 [ ] DOOR E/E ACCESS  
 [ ] DOOR ENTRY 1-4 L/R  
 [ ] DOOR FWD ACCESS

(G-VIIA or G-ZZZA to G-ZZZC)  
 (All marks)  
 (All marks)  
 (All marks)  
 (All marks)

#### Take-Off

- ❖ Doors are part of config warning.

#### In Flt

- ❖ Other phases of flt – doors in safe condition providing pressurisation normal i.e. positive cabin diff.

### [ ] Door Aft Cargo / [ ] Door Fwd Cargo

(QRH 1.2 &amp; 1.4 Jun 09)

#### EICAS Msg:

[ ] DOOR AFT CARGO  
 [ ] DOOR FWD CARGO

(G-RAES or G-VIIB to G-YMMU)  
 (All marks)

(QRH 1.4 May 07)

#### Objective:

Reduce cabin diff to reduce risk of door separation.

- ❖ Set 8000 on Ldg Alt Selector. (Reduces cabin diff).
- ❖ Descend to 8000 or MSA whichever highest.
- ❖ Above 10,000ft don O2 masks
- ❖ Depressurise A/C.
- ❖ After T/O get the A/P in!!
- ❖ If decide to jettison fuel - min height for jettisoning is 6000ft. Check MSA.

### EGPWS Warning General

(A[1] 8.3.5.1 Jun 08)

- ❖ EGPWS warning must never be ignored, (from either basic or look ahead enhanced GPWS).
- ❖ Advise ATC.
- ❖ ASR and Tech log entry
- ❖ Never pull C/B, unless directed by QRH/manual.

#### Below MSA

- For any hard warning execute a EGPWS Pull UP G/A unless all criteria below are satisfied:–
  - Day
  - Below 1000ft aal
  - Clear visual conditions
  - RWY in sight
  - Stabilised in ldg config (on G/S with approach power set)
  - Ldg checklist complete
  - Obvious to crew that no danger in respect of terrain, config, or flt path.
- If there is any uncertainty, then execute full energy EGPWS G/A.

#### Above MSA

- Assess A/C posn, altitude, and vertical speed. Any doubts execute full energy EGPWS G/A.

**GPWS Warning “PULL UP” /Terrain Avoidance #**

(QRH MAN-1-4 Mar 09)

**Aural:** “PULL UP” or “TERRAIN TERRAIN PULL UP” or  
“OBSTACLE OBSTACLE PULL UP” (YMMG - YMMU)

**PFD:** **PULL UP** (red)

CALL ..... “PULL UP G/A”  
 A/P & A/T ..... DISCONNECT  
 THRUST LEVERS aggressively ..... MAX THRUST (certified)  
 ATTITUDE ..... LEVEL WINGS: ROTATE 20° NU  
 SPEED BRAKES ..... RETRACT  
 If grnd contact a factor – continue rotation to PLI or initial buffet/stick shaker.  
 Use whole hand to sweep the T/Lever AND Spd Brake forward.

- ❖ Never ignore EGPWS warning.
- ❖ Below MSA complete full energy Pull Up manoeuvre on all occasions, (exceptions see A[1] 8.3.5.1)
- ❖ At or above MSA assess a/c position, altitude, & VSI. Obvious false warnings may be disregarded. **If MSA in doubt – Pull Up.**
- ❖ Act immediately, no hesitation - smoothly go for the stick shake. (Dave Warren)
- ❖ Smooth, steady control to avoid overshooting pitch attitude
- ❖ PLI will come down to meet you as you raise the nose.
- ❖ Aft control column forces increase as airspeed decreases.
- ❖ Any stick shaker / buffet must be regarded as the max pitch limit.
- ❖ Do NOT change config or trim setting.
- ❖ Do NOT use F/D commands.
- ❖ Climb to MSA, or until warning stops.
- ❖ After warning ceases – do the QRH which leads to....
- ❖ What caused the warning:
  - \* A/C Position?
  - \* Radio & servo altimeters? – correct QNH / Altimeter settings?
  - \* MSA correct? Check posn with radar.

**Exceptions to Pull Up**

(A[1] 8.3.5.1 Jan 11)

If below MSA and the following criteria are met, approach can be continued. Any uncertainty: full energy EGPWS G/A:

- \* Day, with clear VMC
- \* Below 1000ft AAL
- \* RWY in sight
- \* Stabilised in ldg config & Ldg c/list complete
- \* Obvious to crew no danger from terrain, a/c config or current flt path.

**Notes**

HP gets tunnel vision. Therefore...

NHP to call RA's / FPV whichever most critical. (VSI may be climbing, RA descending).

- Easy to forget S/Brakes. Therefore, use open hand/arm to push T/Levers & S/Brake forward together. (JP)
- Note how this action is completed manually. No option for A/P. This is because the automatics have (probably) got you into trouble in the first place. Wrongly programmed perhaps? (JP)
- If QNH is wrong, climbing to MSA with no correction, gives degraded terrain clearance.
- R of D = 3 × A/C Ht will trigger GPWS warning. e.g. 3000fpm @1000R.
- File ASR for hard (red) GPWS warnings.

**GPWS Caution (amber - soft) warnings**

(QRH MAN-1-4 Mar 09 &amp; TM[FC2] 15-20-24/26 Apr 03)

**EGPWS:** SINK RATE, TERRAIN, DON'T SINK, TOO LOW GEAR, TOO LOW FLAPS,  
TOO LOW TERRAIN, GLIDESLOPE, BANK ANGLE.  
CAUTION TERRAIN. [CAUTION OBSTACLE: YMMG—YMMU only].

**Notes:**

- On receipt of caution, check: correct flt path; select gear dwn/flaps as appropriate; altimeter subscale and NAV accuracy. (A[1] 8.3.5.1 Jul 09)
- The below G/S deviation alert can be cancelled/inhibited for LOC/BB approach, circling approach from ILS, unreliable G/S signal or deliberate app below G/S.
- Under daylight VMC conditions, with positive visual verification of no obstacles/terrain, approach may be continued.

**PWS & GPWS WINDSHEAR Warnings #**

(QRH MAN-1-10 May 07 &amp; FCom1 SP-16-20 Jun 09)

**Aural:GPWS**

“WINDSHEAR” and two tone SIREN.  
 or PWS “WINDSHEAR AHEAD” during T/O,  
 “G/A WINDSHEAR AHEAD” during approach  
 “MONITOR RADAR DISPLAY” caution during/after T/O.

Windshear G/A	
HP	NHP
<b>MANUAL FLIGHT</b> <ul style="list-style-type: none"> <li>• Call “Windshear Go Around”.</li> <li>• Push either TO/GA switch.</li> <li>• Aggressively apply maximum thrust.</li> <li>• Disconnect autothrottle.</li> <li>• Simultaneously roll wings level &amp; rotate to initial pitch attitude of 15°</li> <li>• Retract speedbrakes (lever down).</li> <li>• Follow F/D TO/GA guidance (if available).</li> </ul>	<ul style="list-style-type: none"> <li>• Verify maximum thrust.</li> <li>• Verify all actions have been completed. Call out any omissions.</li> </ul>
<b>AUTOMATIC FLIGHT</b> <ul style="list-style-type: none"> <li>• Call “Windshear Go Around”.</li> <li>• Press either TO/GA switch. (If TOGA not available disconnect A/P &amp; A/T)</li> <li>• Verify TO/GA annunciation.</li> <li>• Verify thrust advances to GA power.</li> <li>• Retract speedbrakes (lever down)..</li> </ul>	<ul style="list-style-type: none"> <li>• Verify maximum thrust.</li> <li>• Verify all actions have been completed. Call out any omissions.</li> </ul>
<b>PRECAUTIONS (Man/Auto)</b> <ul style="list-style-type: none"> <li>• Monitor system performance (AFDS may not cope with severe W/shear – disconnect A/P + A/T)</li> <li>• Do not change gear or flap config until W/shear no longer a factor.</li> <li>• Monitor vertical speed and altitude.</li> <li>• Do not attempt to regain lost airspeed until W/shear no longer a factor.</li> </ul>	<ul style="list-style-type: none"> <li>• Monitor vertical speed &amp; altitude. Call ‘climbing/ descending’.</li> <li>• Call any trend toward terrain contact, descending flight path, or significant airspeed changes.</li> </ul>

- ❖ Emphasis on following F/D!!!! F/D initially commands 15° or PLI whichever lower. Then transitions to speed control.  
Uses current or IAS window speed whichever greater. (TM[FC2] 04-20-19 Apr 03)
- ❖ Easy to forget S/Brakes. Therefore, use open hand/arm to push T/Levers & S/Brake forward together. (J Potter)
- ❖ Do not change config or trim setting. PLI will come down to meet you as you raise the nose.
- ❖ HP gets tunnel vision. Therefore, NHP to call Rad Alts/FPV/sig speed changes whichever is critical.
- ❖ Before V1, reject T/O for “WINDSHEAR AHEAD” & “MONITOR RADAR DISPLAY”
- ❖ Note inhibits: **WINDSHEAR AHEAD – Inhibited 100kts—50R**  
**MONITOR RADAR DISPLAY – Inhibited 80kts—400R**
- ❖ “MONITOR RADAR DISPLAY” caution just requires manoeuvre to avoid W/Shear except during T/O roll. (R Izon)
- ❖ Follow QRH even after T/O, for “WINDSHEAR AHEAD” & “MONITOR RADAR DISPLAY”
- ❖ F/D gives W/Shear recovery commands if GPWS warning, otherwise normal TOGA commands 2000fpm.
- ❖ If LLWS warnings in effect at A/F, G/A brief to include no config change except S/Brakes.
- ❖ With any GPWS ‘WINDSHEAR’ warning - Windshear G/A is mandatory. (A[1] 8.3.8.3.1 Jun 08)
- ❖ Call of ‘WINDSHEAR G/A’ means that a positive rate of climb will be maintained at the expense of airspeed, even unto the stick shake. (A[1] 8.3.8.3.1 Jun 08)
- ❖ Exceptionally, if extreme turbulence is associated with strong winds (NOT CB or FRONTAL activity) a warning can be treated as advisory if:– (A[1] 8.3.8.3.1 Jun 08)
  - \* Warning anticipated,
  - \* Briefed for in Approach Briefing,
  - \* Appropriate allowance made.
- ❖ File ASR for windshear G/A.

**Identification of unacceptable flt path deviations below 1000R**

Uncontrollable changes in excess of:–

- 15 kts IAS
- 500 fpm VSI
- 5° pitch attitude.
- 1 dot displacement from G/S
- T/Levers in unusual position for significant time

(A[1] 11.6.1.3 Jun 08)

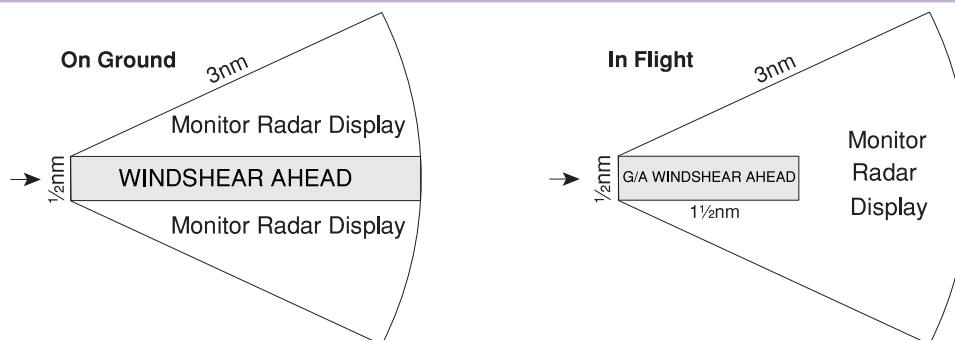
Inform ATC if on T/O or Approach.

**Windshear Encounter During Takeoff Roll- On Runway**

If windshear encountered below V1, providing sufficient runway available, reject takeoff.

If windshear encountered near the normal Vr, but with insufficient runway to either stop or accelerate back to Vr, apply FULL power and fly normal rotation at least 600 metres before the end of the runway, even if airspeed is low. High nose up attitudes may be required to lift off in the remaining runway.

## PWS WXR radar coverage



## GPWS Windshear Alert & PWS (Summary)

(TM[FC2] 15-20-29 Apr 03)

### GPWS gives immediate warning that you are IN windshear.

(Excessive down draught or TWC)

Aural: Two tone SIREN + “WINDSHEAR - WINDSHEAR - WINDSHEAR”  
 Visual: PFD: Red WINDSHEAR message, Red MASTER Warn lights.  
 Active: From rotation and below 1500R.

With any ‘WINDSHEAR’ warning - Windshear G/A is mandatory. (A[1] 8.3.8.3.1 Jun 08)

(with one exception).

### PWS (Predictive Windshear) gives alerts of windshear ahead.

WXR radar scans for windshear when:

- On grd, T/Levers in T/O range or
- In flt, < 2300R

#### PWS On T/O

Aural: “WINDSHEAR AHEAD - WINDSHEAR AHEAD”  
 Visual: PFD: Red WINDSHEAR message,  
 ND: red message & symbol,  
 Red MASTER Warn lights.  
 Active: From T/O roll to 1200R. windshear within 3nm, & directly ahead.  
 Inhibits: New warnings inhibited 100kts—50R.  
 Handling: On T/O: Before V1:— STOP.  
 On T/O: After V1:— perform WINDSHEAR G/A.

#### PWS On APP

Aural: “G/A - WINDSHEAR AHEAD”  
 Visual: PFD: Red WINDSHEAR message,  
 ND: red WINDSHEAR message & symbol,  
 Red MASTER Warn lights.  
 Active: on APP below 1200R. windshear within 1.5nm, & directly ahead.  
 Inhibits: New warnings inhibited < 50R. PWS alerts inhibited between 2300R and 1200R.  
 Handling: Perform WINDSHEAR G/A.

#### PWS On T/O & Approach (Caution)

Aural: “MONITOR RADAR DISPLAY”  
 Visual: ND: amber WINDSHEAR message & red windshear symbol.  
 Active: From T/O roll and on Approach below 1200R. Windshear within 3nm, & ahead.  
 Inhibits: New caution alerts inhibited: T/O: 80kts—400R & APP: < 400R.  
 Handling: On T/O: Before V1:— STOP (expect a low speed RTO).  
 On T/O: After V1:— use HDG to steer clear.  
 On App:— TOGA then Hdg SEL to avoid. ALT capture may occur. Reselect TOGA.

#### Note:

A WINDSHEAR warning inhibits most other GPWS, PWS, TCAS voice warnings.  
 Not all W/Shear types are detected by WXR radar.

GPWS Windshear Alert & PWS Summary

(TM[FC2] 15-20-29 Apr 03)

Windshear Warnings & Actions			
Flight Phase	GPWS < 1500R	PWS <1200R	
	WINDSHEAR Warning Siren with “Windshear, Windshear Windshear”	WINDSHEAR Caution  “Monitor Radar Display”	WINDSHEAR Warning “Windshear ahead, G/A Windshear ahead”
T/O roll (before V1)	N/A	RTO up to V1	RTO up to V1
After T/O (after V1)	Windshear G/A	Manoeuvre to avoid	Windshear G/A
Approach	Windshear G/A	Manoeuvre to avoid TOGA / Hdg Sel	Windshear G/A



Windshear Ahead - Warning

■ **TCAS Resolution Advisory (RA) Warning #**

(QRH MAN-1-6 Mar 09)

**Aural:**CLIMB/ CLIMB CROSSING CLIMB / REDUCE CLIMB  
DESCEND / DESCEND CROSSING DESCEND / REDUCE DESCENT**PFD:****TRAFFIC** (red)

(TM[FC2] 15-20-12 Apr 03)

**Condition:**

- (red) RA: target is 20—30 secs of Closest Point of Approach (CPA).
- (amber) TA: target within 30—40 secs of CPA. (TM:– 25—45secs).
- ◆ (white) Proximate traffic: Within 6nm, or 1200ft.
- ◇ (white) Other traffic: Normally within 15nm.

**Handling Notes**

- “MONITOR VERTICAL SPEED” RA’s do not require manoeuvre.
- “ADJUST VERTICAL SPEED, ADJUST” RA’s always require a REDUCTION of vertical speed.  
(TM[FC2] 15-20-17 Apr 03 / 3 Fleets Dec 03)
- US ATC do not expect a/c to follow the TCAS RA if already alerted to conflicting traffic. ASR required if this a problem.  
(New Horizons Apr 07)
- ‘TA Only’ to be selected in flight, only when specified by QRH.  
(A[1] 8.3.6.10 Jun 08)
- TCAS RA’s must always be followed.
- With high vertical rates, may get TCAS RA while one or both A/C are short of cleared levels. No loss of ATC clearance implied.

TCAS RA (except climb in Ldg config)	
HP	NHP
If manoeuvre required: Disengage A/P and A/T Smoothly adjust pitch and thrust to satisfy RA command. <i>(PFD red boxes and VSI indications)</i> <i>Follow planned lateral flt path unless conflicting traffic dictates otherwise.</i>	Advise ATC “c/s TCAS RA”
	Additional calls: “Clear of conflict, returning to FLxxx” “Clear of conflict, FLxxx resumed” or “Unable. TCAS RA”
Establish visual contact. Call out the traffic.	
<b>Warning: Do not follow a DESCEND (fly down) RA below 1000 ft AGL</b>	



**TCAS "CLIMB" RA In Landing Config #**

(QRH MAN-1-7 Mar 09)

TCAS Climb RA (in Ldg config)	
HP	NHP
Disengage A/P AND A/T Advance Thrust to maximum Flaps 20 Smoothly adjust pitch to satisfy RA command. <i>(PFD red boxes and VSI indications)</i> <i>Follow planned lateral ft path unless conflicting traffic dictates otherwise.</i> Positive rate: "Gear Up"	Verify max thrust set Position flaps to 20 detent  "Positive Climb". Position Gear up
(This is not a G/A - no not use TOGA on this one)	Advise ATC "c/s TCAS RA"  Additional calls: "Clear of conflict, returning to FLxxx" "Clear of conflict, FLxxx resumed"
Establish visual contact. Call out the traffic.	

**General TCAS Notes**

**A TCAS RA must always be followed**  
**Do not follow "DESCEND" RA below 1000ft AGL**  
**If ATC issue conflicting instructions, must follow the TCAS**

- Advise ATC "TCAS RA" and "Clear of conflict"
- Excessive pitch rates are not required. Respond within 5 secs.  
 Attitude =  $1000 \div \text{TAS}$ . ( $5^\circ$  @ 200kts,  $2\frac{1}{2}^\circ$  @ 400kts). Make change to pitch – do not chase VSI.

**Do not change vertical speed during RA unless TCAS commands change. Loss of separation may occur during TCAS to TCAS negotiation.**

- Do not manoeuvre in opposite direction to RA.
- Limit manoeuvres to the minimum sufficient to comply with the advisory, and start to return to the original clearance as soon as weakening RA permits.
- A 'MAINTAIN VERTICAL SPEED' may involve crossing with other traffic without the normal 'CROSSING' command.
- Do not use F/D commands until clear of conflict.
- During an approach with an RA - follow the RA Don't press TOGA - it is not a go-around.
- Once clear of conflict you may then have to make a go-around!
- If the A/T were left in during the RA, you may not have speed protection depending on the AFDS mode. Switching off the F/D's (which you are no longer following) will give you SPEED mode on the A/T. (Just a thought). *(Flt Ops News May 08)*
- Capt may elect to switch to 'TA ONLY' on close parallel RWYs.
- If stick shaker / buffet occurs – immediately recover stall, (TCAS continues with RA commands).
- If high speed buffet occurs - relax pitch to reduce buffet, continue with RA.
- Normal surveillance range is 15nm, but varies according to traffic density.
- TCAS will command manoeuvres outside A/C envelope.
- If TCAS on BOTH MAP displays is OFF, any TA/RA TCAS event will pop up on the MAP display. If only one MAP display is selected then there is no pop up feature for the display not selected.
- In addition to the PFD, note the VSI display. The VSI needle will display red or white, which can be a useful guide.
- All TCAS RAs are inhibited below approx 1000R, and when GPWS/WINDSHEAR warnings active.
- All 'DESCEND' RAs are inhibited below approx 1100R.
- 'INCREASE DESCENT' RAs inhibited below approx 1500R, when on approach. *(TM[FC2] 15-20-42 Oct 03)*
- File ASR for TCAS RA's.

**Altitude Report Failure**

(A[1] 8.3.6.3 Jun 08)

If ATC report altitude read outs are failed, or intermittent, select another source or switch off altitude reporting. Failure to do so can lead to serious TCAS problems, leading to a loss of separation.



# 12 • Miscellaneous

## Handling Difficult Passengers

- ❖ **Use your authority to maximum advantage.** Your jacket and cap are powerful symbols of authority.
- ❖ **Choose the location to suit yourself** - is there a location with a height advantage for yourself - can you stand while they sit?
- ❖ **Offer a handshake and your name and ask for their name.** This will formalise and normalize the relationship.
- ❖ **Allow the passenger their first rush.** They will run out of breath sooner or later and you will avoid interrupting them.
- ❖ **Ask them to restate their problem.** This should give a more rational account of their problem.
- ❖ **Recap their points and ask questions.** Recap to gain agreement and question them to make them think - it's hard to think up angry answers.
- ❖ **Try a 'sideways step'.** Something not directly associated with their initial complaint - this could well break their 'angry' chain of thought and argument.
- ❖ **Offer help** - 'Would you like me to do this for you'. Ask them if this would help - again thinking is hard work.
- ❖ **Look for a hidden agenda or underlying reason.** e.g. are they looking for an up-grade or are they a nervous flyer.
- ❖ **Stay calm and don't patronise or belittle them.** To do either could wind them up again.
- ❖ **Consult Ops via ACARS** - they will be able to supply their itinerary as booked not as they say its booked!

## IFE (A pilots guide)

### Some IFE problems

MCU2                      Fault Lt ON. Videos in pause mode.  
Cure:-                      Shutdown system, wait 15 min before switching ON and rebooting.  
                                    Note PC takes time to shutdown after pwr removed.

GE-Marconi Sys:-

ID for restart        GMIS02 }                      ID code asked for + re-enter same code as the Security code.  
or                      GMIS03 }

Rockwell collins:-

ID for restart        BAENG1  
or                      ENGSUP  
or                      BACREW

ACARS for problems... LHRGPBA    'Total Cabin Maintenance'

Note the reset button on the bottom of the screen cabinet.

A red Lt @ Door 1L panel should be OFF. (If on = no power)

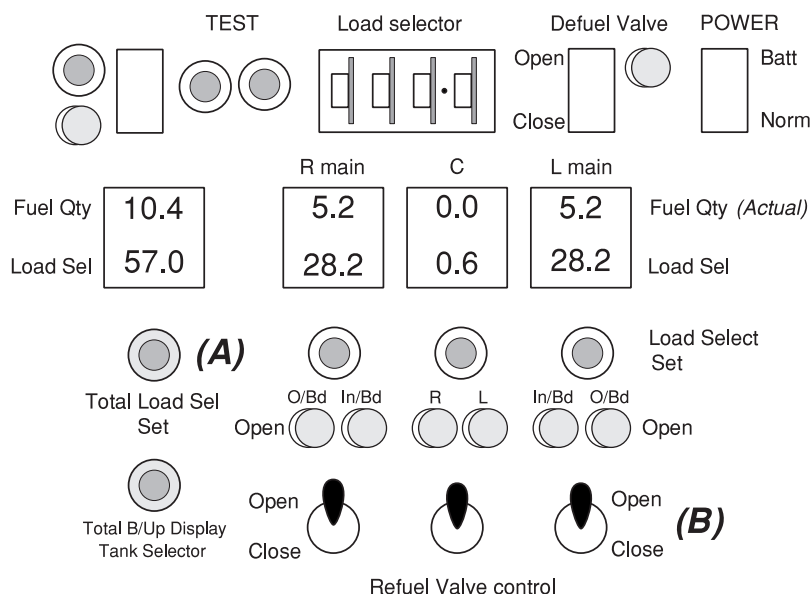
Other ways of curing persistent problems is to reboot electrics on the ground. Try the Electrics isolation switches.

If the IFE won't start because the "PA in Use" is shown in the CDU on the pedestal (i.e. the system thinks the PA is in use) select PA on the comms panel, key the mike to clear the message, and all should be well.

## Collecting 777 from unfamiliar A/F

- ❖ CIRRUS Plan
- ❖ A/F perf figures
- ❖ Flt Plan filed
- ❖ Let down plates/SIDS
- ❖ A/F RWY bearing strength
- ❖ A/F Fire classification
- ❖ Loadsheet details, (has A/C been changed — change of pallets/Bins?)
- ❖ Serviceability of APU
- ❖ Defects/ Dispensations
- ❖ Handling Co.? English speaking? (Do we need interpreter?)
- ❖ Handling Personnel:–
  - \* Qualified refuelling staff,
  - \* Engineering — are we taking our own (ramp qualified?).
- ❖ Availability of:–
  - \* Grnd Electrics,
  - \* Grnd Air Supply,
  - \* Tugs/ Tow bars,
  - \* Deicing.
- ❖ A/F facilities, Customs, Times of operation
- ❖ Pax:–
  - \* Medical problems — Medical personnel?
  - \* Security problems — Head of state/body guards?
- ❖ Over night bag.

## Refuelling (A pilots guide)



- ❖ Check bowser meter is zero. (Clement Rodrigues: Engineer AUH/DXB)
- ❖ Obtain specific gravity (kg/L or lbs/USG)
- ❖ Calc the difference between the Departure fuel and the actual on board and use the SG to calculate the uplift in Litres.

E.g....

Before refuelling	10400 kg	SG = 0.780
Required	57000 kg	
Uplift	46600 ÷ 0.780 kg/L = 59743 L approx.	

- ❖ Ensure all refuel panel switches are in OFF/AUTO (FRM p 101 Sep 01)
- ❖ Use power switch to set power to BAT.
- ❖ Select required fuel (57.0) on the thumb wheel and press Load select switch (A) 1 sec. (Actually select 300Kgs more than required so tank shuts off at the correct figure). The required figure will display as the total on the left most gauge and will auto distribute into the L, C & R tank gauges.
- ❖ Switch on L, C & R valves (B). Blue valve lts ON. Signal bowser operator to start pumping.
- ❖ Normalize panel after required uplift is loaded. (BATT to NORM)
- ❖ Note 1: pushing the load select twice blanks the load required. There is no preselect protection if this is the case. The tank will shut off only when full.
- ❖ Note 2: Txfer fuel from centre tank to mains is possible by opening the defuel valve.
- ❖ Closing panel - needs a knack. Panel is locked open by 2 telescopic hinges. Around the telescopic part is a thin black metal ring. To release the lock, slide the ring down the telescopic part, approx ¼ in, away from the access panel. Panel can now be closed and latched.

## Conversions

T/Log SG requires kgs/Ltr but US quotes density as lbs/USG.

USG x 3.78531 = Litres.

To convert lbs/USG to kg/L, multiple by 0.11983



# 13 • Limitations

## Wind Limitations [#]

(FCom1 L-10-1 Oct 2001 / L & Bal 04-02-01 Jan 00)

	Max Wind Strength		
	On Ground (stand)	On Ground (taxi)	
Doors Open	65		
Operating Doors	40		
Aircraft		65	

	Max Cross Wind Components		
	T/O	Man Ldg / CAT 1 A/Land	Autoland (A/L USA)
Dry	40	40	25
Wet	25		(15)
Contaminated	15	15	15 ??
PVD T/O	15		

	Max Tail Wind Components		
	T/O	Man Ldg	Autoland
All conditions except...	15	15	15
Slippery or reduced BAction	Not Approved (Perf Man 5.1.5)	5	5 (Perf Man 4.1.5)
		+ requires FULL reverse on BOTH engs if Slippery.	

#	Runway slope	±2%
#	Max T/O & Ldg altitude	8,400 ft PA
	Max operating altitude	43,100 ft PA

## Co-Pilots' Limits

(A[1] 5.2.2.1.1 Jun 08)

T/O - Min 600m RVR & cross wind limits of 2/3 A/C limits.

Ldg - Min CAT 1 (or NP Approach) AOM & cross wind limits of 2/3 A/C limits.

2/3 of 40kts — 26kts

2/3 of 25kts — 16kts

## Gross Wts [#]

(FCom1 L-10-2 Jan 09 / OMN 17/11)

G-VIIO—VIIR wts changed to save money, was: Taxi Wt 287,804 & MTOW 286,897

(FCN 23/04 Dec 04)

Reg/Eng	Cirrus	Max Taxi Wt	MTOW	MLW	MZFW
G-ZZZA - ZZZC GE90-76B	777GA	243,570	242,670	201,840	190,500
G-VIIA - VIIN G-VIIS, VIIU - VIYY G-RAES GE90-85B	777GE	268,526	267,619	208,652	195,044
G-VIIO - VIIR, VIIT GE 85B/90B (AML)	777GE	275,907	275,000	208,652	195,044
G-YMMA - YMMU RR Trent 895	777ER	298,010	297,556	208,652	195,044
G-STBA - STBF 777-300ER GE90-115B	777	341,101	340,194	251,290	237,682

**G-STBA – G-STBC taxiing in strong winds**

(FCom1 L-10-7 Jun 10)

For tailwinds/crosswinds between 30 – 45 kts, do not exceed 70% N1, (except for T/O!!) Above 45 kts do not exceed normal taxi power.

**Min No of Crew with PAX**

(FCom1 L-10-8 Jun 10)

From Main base 777 – 200: 2 pilots / 8 cabin crew.

From Main base 777 – 300: 2 pilots / 10 cabin crew.

Downroute min CCrew is reduced by 1, but ASR required, & direct vision requirements must be met.

**Max No of PAX**

(FCom1 L-10-4 Mar 03)

440 with 9 Cabin crew (Children <3 can be ignored).

Type	F J W M	(Total)	FICO	CIRRUS	(L & B Sep 00)
A Mkt	17/48/24/126	(216)	P7		
B Mkt	14/48/40/122	(224)	V7 (U7 @ LGW)		
RR, No 1st	0/36/24/212	(272)	L7		
GE, No 1st	0/40/24/216	(280)	H7		
RR	13/48/32/127	(220)	W7		

**Max Speeds**

(FCom1 L-10-12 Jun 10)

Mmo: 777 – 200	M0.87 above FL 300 (to FL 431)	Mmo: 777 – 300	M0.89 above FL 280 (to FL 431)
Vmo: 777 – 200	330kts below FL 300	Vmo, Va: 777 – 300	330 – 350 kts below FL280 (approx)

**Speed & Fire Cat**

777 speed cat is Cat D. Fire cat = 9

**Turbulent Air Penetration (Severe turbulence)**

(FCom1 SP-16-19 Mar 08)

270kts below 25000ft.

(FCom1 L-10-2 Jan 09)

280kts / M0.82, whichever is lower, at and above 25000ft.

Maintain a min of Min Manoeuvring speed (amber band) + 15kts when below M0.82, at all altitudes.

(FCom1 L-10-2 Jan 09)

If severe turb. below 15000ft and < Max ldg wt: A/C may be slowed to 250kts, with adequate stall margins.

(FCom1 SP-16-22 Oct 08)

Note: 1.3g manoeuvre capability occurs at 40° bank in level flt.

(FCom2 10-10-5 Jun 09)

**Performance Corrections**

(PerfM. 3-3-2 Feb 97)

<b>T/O</b>	Anti-Icing correction	1400 kg	
	Press Alt	300 kg/mb <1013	
<b>Ldg</b>	WAT correction	–4000 kg/°C if OAT > published max temp.	(PerfM. 4-1-3 Feb 97)
	Avoid ldg in slush/water	> 13mm (0.5in)	
	or snow	> 10cm (4 in)	

**Eng Warm Up Requirements / Recommendations**

(FCom1 NP-40-7 Jan 09)

RR Requirements:

- ❖ Engs off for > 1.5 hrs run eng for 5 mins or more
- ❖ Engs off for < 1.5 hrs run eng for 3 mins or more
- ❖ Use normal taxi thrust setting
- ❖ Eng oil temp above the lower amber band before T/O

GE Requirements:

- ❖ Eng oil temp above the bottom of the temp scale.

GE Recommendations:

- ❖ Run eng for 3mins or more
- ❖ Use normal taxi thrust setting

**Eng Cool Down Recommendations**

Eng cooldown time: RR 1 min: GE 3 mins. Use only taxi power.

(FCom1 NP-80-2 Jan 09)

**RR Eng Oil System (G-YMMA – YMMU)**

Oil temp must be > –40 for engine start, and 50°C before T/O power set

(FCom1 L-10-6 Jun 10)

## APU Limits

Do not start or shutdown during refuelling.

(FCN 14/01 01)

APU can be started up to a/c operating limit (43100ft)

(TM[FC2] 07-30-01 Apr 03)

Bleed is available at or below 22000ft.

Electrics takes priority over bleed air.

## Pressurisation Limits

(FCom1 L-10-3 Jan 09)

Max cabin diff 9.1 psi

Max for T/O & Ldg 0.11 psi (190ft).

Max operating diff 8.6 psi

Max cabin alt 8000ft

APU supplies air up to 22000ft

Masks deploy at Approx 13500ft

(TM[FC2] 01-40-11 Apr 03)

Air Conditioning Pack u/s Maintain F350 or below. 60 mins rule.

(MEL 21-51-1 Mar 04)

Max alt for revenue flt 8000ft

(A[1] 8.12.5 Jun 08)

## Navigation Limits

(TM[FC2] 04-20-6 Apr 03)

❖ Min height for turns 400ft

(A[1] 3103 Dec 05)

❖ Min circling altitude 1000ft aal

(FCom1 L-10-9 Jan 09)

❖ ETOPS rule time 180 mins

❖ ETOPS rule dist 1200 nms

❖ Max angle for LOC cap 120°

❖ Max angle for G/S cap 80°

❖ QFE Ops:

❖ LNAV - use not permitted in QFE ops.

(FCom1 L-10-8 Oct 04)

❖ VNAV - use not permitted in QFE ops, below transition height or level

(FCom1 L-10-8 Oct 04)

❖ VNAV not to be used below transition height or level.

(FCom1 NP-10-9 Mar 06)

**VNAV altitudes in the FMC are not referenced to QFE**

Top tip for QFE ops: Delay descent to a QFE altitude until ready for an approach or following an inbound procedure, so you can continue with LNAV as long as possible.

## Fuel Spec

(Gen Knowledge)

# JP-4 & Jet B (wide cut) fuel prohibited.

Fuel spec	Freezing Pt
JetA1/AVTUR	-47° C
JetA (USA)	-40° C
RT/TS-1 (CIS states)	-50° C

## Eng Fuel Limits

(FCom1 L-10-6 Jun 10)

# Max tank Fuel Temp: 49°C (120°F)

# Min Fuel Temp in flt: Fuel Freeze point + 3°C

# Min Fuel tank Temp for T/O: GE Not less than -40°C or 3° above FF point whichever is higher.

# Min Fuel tank Temp for T/O: RR Not less than -37°C or 3° above FF point whichever is higher.

(Only a problem if load fuel with FF point below -40°C).

RR A/c – after refuelling, if Fuel Temp  $\leq 0^{\circ}\text{C}$  or fuel temp gauge u/s, ensure that the Fuel Circulation maintenance action has been done.

Low fuel: with 2000 kg or less, in any main tank - avoid excessive body angles/accel.

Recommended min alt for fuel jettison: 6000ft.

(QRH 12.6 Sep 04)

Jettison rates 2500 kg/min with CWT fuel; else 1400 kg/min.

Fuel stack levels: 5200 kg/ main tank (10400 kg).

(TM[FC2] 20-7 Apr 03)

Do not operate the HF radios whilst refuelling.

(FCom1 L-10-7 ???????)

## Fuel Leaks

(QRH MAN-50-2 May 07)

Steady increase in fuel imbalance or difference between totaliser and calc fuel of  $> 500$  kg/30 mins.

## Fuel Loading

(FCOM1 L-10-7 Jan 09)

# Fill wing tanks before CWT.

Note: Up to 1360 kgs allowed in CWT if main tanks not full, provided CWT fuel plus actual ZFW does not exceed Max ZFW and CG is within limits.

Following a -40° fuel sector, if A/C fuelled with -47° fuel, freeze point can be taken as -42°.

-40° fuel in the centre tank is not a factor.

## Max Usable Fuel

(TM[FC2] 12-20-6 Jun 10)

Type	L Main (L)	Centre (L)	R Main (L)	Total (L)	Tot Kgs (0.8 SG)
777 A model (-200)	35,204	46,939	35,204	117,347	93,877
777 IGW (-200ER)	36,188	98,799	36,188	171,175	136,940
777-300ER	38,989	103,303	38,989	181,281	145,025

CWT starts to fill at:

(L &amp; B 01-01-02 Nov 01)

A Model: 70408 L or 56.3 tons (0.8SG)

IGW model: 72376 L or 57.9 tons (0.8SG)

777-300 model: 77978 L or 62.4 tons (0.8SG)

## Fuel Spillage

(A[1] 2.14.12 Jun 08)

Spillage > 2m (6ft) requires fire services, possible rapid disembarkation, & no movement within 15m (50ft).

Do not operate WXR radar within 50ft of fuel spill.

(FCOM1 L-10-2 Jan 09)

## Landing Gear Limits

(QRH 14.3 Sep 03)

Extension/Retraction 270/M0.82

If using gear for drag: not greater than 200kts

(FCOM1 NP-70-7 Jan 09)

To assist extension with Altn Gear 240kts

## Tyre Limits

(FCOM1 SP-01-6 May 07)

Min tread: 2 mm over ¾ tyre circumference.

Tyre Cut limit: ¾ in. (ref????)

Tyre speeds ??

Hydroplaning speed starts at  $9\sqrt{P}$  and can persist down to  $7.7\sqrt{P}$ .

At 220 psi this is equivalent to 133 to 114kts.

(D R)

Brake wear indication (Brakes set): 1/32 inch (0.9 mm) above flush = 20 landings

(FCOM1 SP-01-8 May 07)

## Flap Limits (Placarded)

(TM[FC2] 09-10-9 Apr 03)

	Manoeuvre speeds	Flap Limits		
		G-ZZZA - ZZZE GE90-76B	Rest of Fleet 777-200ER	777-300ER
Flap 1 (Slat only)	Vref30 + 60	240	255	265
Flap 5 (T/O flap)	Vref30 + 40	220	235	245
Flap 15 (T/O flap)	Vref30 + 20	200	215	230
Flap 20 (T/O flap)	Vref30 + 20	190	195	225
Flap 25 (Ldg Flap)	Vref30 + 5	180	185	200
Flap 30 (Ldg Flap)	Vref30	170	170	180

Flap/Slat extension inhibited >250kts OR >20,000ft. G-ZZZA - G-ZZZE

Flap/Slat extension inhibited >265kts OR >20,000ft. 777-200ER

(TM[FC2] 09-20-17 Apr 03)

For the new -300: min clean speed is 225 kts at MLW. Consider implications in the TMA



**A/P Limits**

(FCom1 L-10-4 Jan 09)

- # After T/O do not engage A/P below 200 agl
  - # Disengage A/P below 200 agl unless LAND2 or LAND3 annunciated
  - # Disengage A/P before MDA-50ft unless coupled to ILS G/S & LOC, or in G/A mode
  - # after EFATO do not use FLCH until flaps up & speed at or above Vref30+80
  - ❖ Min A/P height on a 'B' RWY is 100R.
- Note: aileron trim switches are inhibited with A/P engaged

**Autoland Limits**

(FCom1 L-10-4 Jan 09)

- # Max G/S angle 3.25° } Only applies to A/Land
- # Min G/S angle 2.5° } Only applies to A/Land

# A/Land approved for:-

- Flap 20 or 30, (But not F25)
- Single eng (F20) or both engs (F30) operating
- Must have LAND2 or LAND3 annunciated.

SLATS DRIVE EICAS msg must NOT be displayed.

(NB – if have FLAP DRIVE msg and have F20 set, A/Land is OK).

# No Auto Land above MLW except in emergency & if immediate landing imperative, e.g. uncontrolled fire or smoke.

**RVSM (FL 290 – 410)**

(FCom1 SP-26-1 Jun 09)

- ❖ Min Equipment:-
  - \* 1 × A/P, with height keeping facility
  - \* 2 × Air Data Systems, i.e. altimeters
  - \* 1 × Transponder
  - \* 1 × Alt Alert System
- ❖ On the ground: max allowable difference between main altimeters and A/F elevation = 75ft. (Standby altimeter is not RVSM capable). (FCom1 L-10-2 Jan 09)
- ❖ During the walk round, pay particular attention to ports, probes and surrounding fuselage.
- ❖ RVSM prohibited if gear down operation. (FCom1 L-10-2 Jan 09)
- ❖ Prior to entry, altimeters within ±200ft. Cross check regularly, with subscales.
- ❖ A/P engaged throughout, except to control height excursions over 150ft.
- ❖ Keep TCAS in TA/RA mode.
- ❖ Max V/S during climb/descent: 1000 fpm within 1000ft of cleared level. Min V/S is 500 fpm (TCAS only detects rates > 500 fpm).
- ❖ Deviations > 300ft – inform ATC and file MOR/ASR.
- ❖ Turn from assigned track with 15 nm offset & ±500ft separation.
- ❖ RVSM requires a serviceable ADIRU, (no NAV ADIRU INERTIAL caution eicas msg). (FCom1 NP-60-6 May 07)
- ❖ Inform ATC if failure of Engine, Altimeter, auto height keeping, or other equipment that affects height keeping.
  - \* Descend to FL 285 or below OR climb to FL 420.
  - \* File ASR
- ❖ WXR avoidance > 10nm – turning N of track descend 300ft / turning S of track climb 300ft. (RIM NA p2 Jun 02)
- ❖ 'W' on flt plan. Do not file this if the a/c is not RVSM capable before departure. See MEL.

**MNPS (FL 285 – 420)**

(FCom1 NP-60-6 May 07)

Approved to enter provided have 2 out of 3 of the following:-

- ❖ ADIRU ( **NAV ADIRU INERTIAL** caution msg not displayed)
- ❖ FMC (FMC advisory msg not displayed)
- ❖ Altn Nav System

The GPS, FMC & ADIRU nav accuracy should be checked every hour. (Know symbols).

**ETOPS rule**

(FCom1 L-10-10 Jun 10)

Rule time is 180 minutes and rule distance is 1200 nm.

**Comms**

- G-RAES, G-VIIA – G-VIIH: VHF radio – On the ground do not use centre VHF for voice ATC comms.
- G-VIIN - G-YMMD: HF radio – deselect all but one HF for transmission to prevent audio interference.

**Min Circling Altitude**

(FCom1 L-10-8 Jun 09)

1000ft AAL

**Weather Radar**

(FCOM1 L-10-2 Jan 09)

Do not operate the Wx radar in a hanger or within 50ft of people or a fuel spill.

The test function is OK.

**Met Vis (sm) to RVR (USA & Canada)**

(AERAD AER 44 &amp; 50 / Perf M 501-1 95 / A[1] 8.1.3.2.8 Jun 08)

USA		Canada		m
RVR (ft) (USA)	Met Vis Quoted (sm)	RVR (ft) (Canada)	Met Vis Quoted (sm)	
1600	¼	1400	¼	400
2400	½	2600	½	800
3200				1000
4000	¾	4000	¾	1200
4500				1400
5000	1	5000	1	1600
6000	1¼			2000

Standard Atmosphere (1.98°/1000ft)			
Altitude	Temp	Altitude	Temp
SL (1013.25mb)	15	25000	−34.5
5000	5.1	30000	−44.4
10000	−4.8	36090	−56.5
20000	−24.6	40000	−56.5

Critical Pt = Distance × GS Home / (GS Out + GS Home)

PNR = Endurance × GS Home / (GS Out + GS Home)

Low Temp Altitude Corrections (En Route)					
Increase published altitudes by...					
Altitude (ft)	5,000	10,000	15,000	20,000	25,000
ISA temp	5.1	−4.8	−14.7	−24.6	−34.5
Std −5	90	190	300	410	540
Std −10	190	390	600	840	1090
Std −15	290	590	920	1290	1680
Std −20	390	800	1260	1750	2290
Std −25	490	1030	1610	2240	2930
Std −30	600	1260	1970	2750	3600

Low Temp Altitude Corrections (TMA)								
Increase published altitudes by...								
HAA (ft)... ----- Temp C	200	400	600	800	1,000	1,500	2,000	3,000
0	20	30	40	50	60	90	120	170
−10	20	40	60	80	100	150	200	290
−20	30	60	90	120	140	210	280	430
−30	40	80	120	150	190	280	380	570
−40	50	100	150	190	240	360	480	720
−50	60	120	180	240	300	450	600	890

## Mental Calcs

For those who need a little reminder of how to keep a mental plot going....

### Rates of descent on approach

The simple formulae for working out a rate of descent for a given approach angle and ground speed is given by:

$$\text{Rate of descent on a } 2.8^\circ \text{ slope} = \frac{1}{2} \text{ Ground Speed} \times 10$$

Adjust the rate of descent  $\pm 50\text{ft/min}$  by for every  $0.2^\circ$  of slope

Rate of Descent on Approach							
Angle of glide slope							
G/S	2.4°	2.5°	2.6°	2.8°	3.0°	3.2°	3.4°
		JFK13L					JFK13R
140	593			692	741	791	
150	636			742	794	847	
160	678			791	847	904	
170	720			840	900	960	
180	763			890	953	1017	
(kts)	$\frac{1}{2}$ G/S-100	$\frac{1}{2}$ G/S-75	$\frac{1}{2}$ G/S-50	$\frac{1}{2}$ G/S	$\frac{1}{2}$ G/S+50	$\frac{1}{2}$ G/S+100	$\frac{1}{2}$ G/S+150

Note: For hot & high A/F's (high density alt) TAS will be higher, therefore, rates of descent will be higher.

### Profile descents

The 777 provides an excellent means of monitoring a profile descent without constantly doing mental calcs. It's called the metric altimeter which, when selected, gives you the 3.28 times tables. To use, just ignore the last two numbers and treat as nautical miles. For example at 9150m (30,000ft), you need 91nm to landing. Compare this to the DTG on the profile descent page.

At high altitude airfields, you might expect to adjust the figure to take account of the airfields altitude, however, the effects of the higher TAS means the correction is almost cancelled out, as you need a greater distance to slow down.

For an intermediate descent, then try this:

Example: FL360 to be at FL100 within 40nms at 0.8Mach. Height to lose = 160 (as FL), distance 40nm, therefore:

$$\text{Descent angle} = \frac{160}{40} = 4$$

$$\text{Rate of descent} = \text{Mach} \times \text{angle} \times 1000 = 0.8 \times 4 \times 1000 = 3200 \text{ ft / min}$$

### IAS v TAS

A basic way to calculate the TAS from IAS is to add 2%/1000ft:

$$\text{TAS} = \text{IAS} + \frac{2 \times \text{IAS}}{100} \times \text{Altitude (1000 ft)}$$

Example, at 240 kias at 10000ft the **TAS = 240 + [4.8 x 10] = 288**

or an even simpler calculation is:

$$\text{TAS} = \text{IAS} + \frac{1}{2} \text{FL}$$

Example, at 240 kias at FL100ft the **TAS = 240 + 50 = 290**

(Real TAS in this example = 288kts)

## Drift Calculations

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The maximum drift that you can experience depends on two things. The wind speed and your own air speed.

$$\text{Max drift} = \frac{\text{Wind speed}}{\text{Air speed (nm / min)}}$$

Example, at 240kts, with a wind speed of 36kts, max drift = 9°

All you need to do is adjust for the angle of the wind to find the actual drift being experienced.

## Cross Components

---

Finding a cross component depends on the sine tables. A simple way to remember the sine tables is to use an analogue watch face. Assume that the angle off is equal to the number of minutes on the watch and calculate the fraction of the watch covered by those minutes.

Example, at 30° off, then 30 mins is half of the clock face, hence ***sin 30 = 0.50***

Example, at 45° off, then 45 mins is three quarters of the clock face, hence ***sin 45 ≈ 0.75*** actually ***sin 45 = 0.707***

Example, at 60° off, then 60 mins is a whole clock face, hence ***sin 60 ≈ 1.0*** actually ***sin 60 = 0.867***

For practical purposes this works well.

Use the same technique to calculate the actual drift from the max drift calculated above.

## Density Altitude

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To calculate the density altitude the rule of thumb is:

$$\text{Density Altitude} = \text{Airfield Pressure Altitude} + 1000 \text{ ft/8°C above ISA}$$

E.g. Johannesburg, elevation 5500ft amsl. With an OAT of 32°C (ISA+28) and standard pressure the density altitude is 9000ft.

Note: kinetic energy in the A/C varies according to the speed squared.

# 14 • Comms

“Callsign” (function)	Freq	Tel. No.	ACARS
LHR Term 5 (RIM COMMS Pg 3,4,5)			
“Ops Control” (LH Ops Control)	131.9	020 8513 0980	.OPC
“Centralised Load Control” (Final Figs)		020 85640920	.LHRLDBA
FTD – Duty Manager		020 8513 0455	.FCB
FTD – ATC Slots		020 8513 0453	.FCB
FTD - Atlantic		020 8513 0461	.FCB
FTD – Eastern/Africa/S.America		020 8513 0671	.FCB
FTD - Shorthaul		020 8513 0451/2	.FCB
Security (via Ops Control		020 8513 0999	.LHRWQBA
“Speedbird Library” (06-23)		020 8562 0750	.HLI or .LHROCBA
Maintrol LH 747		020 8513 0881	.LHRKEBA
Maintrol LH 777		020 8513 0883	.LHRKEBA
“T5 Engineering” LH		020 3165 0482	.T5E
“T5 Engineering” SH	131.8	020 3165 0482	.T5E
“Ops Control” (SH Ops Control”		020 8513 0970	.OPC
Maintrol 737		020 8513 0883	.LHRKEBA
Maintrol Airbus/757/SH 767		020 8513 0886	.LHRKEBA
LHR “Heathrow Centre			
Pax requests, cust services, bags, medical, ground power, tugs, steps, toilets & water servicing, stand allocations, return to stand, windscreen cleaning.	131.55	020 3165 0517	.LHRT5BA
Flight Connections “Connections”		020 8513 3932	.LHRNCBA
General			
Current Ops			.LHROLBA
Aerodromes & Performance		020 8513 0313 / 1493	.LHRDSBA
Navigation Services (Reroute info)		020 8513 0433 / 1493	.LHROMBA
Crew Report Desk T5		020 3165 0800	.LHRHFBA
Crew Transport		020 3165 0551/2/3	.LHRMTBA
Duty Flight Crew Manager		020 8513 1515	.DFC / .LONQZBA
Transport (GTS)		020 8562 7435 or 7186	.LHRMTBA
Security Duty Manager (+ CCard checks)		020 8513 0999	.LHRWQBA
“Connections Centre”		020 8562 7712 or 7495	.LHRKTBA or .LHRNCBA
BA Health Services		0208 56 27903	
Customer Service Recovery Managers		020 8513 0953	.LHRSLBA
Medlink		001 602 239 3627	.PHXMACR
LGW (RIM COMMS Pg 4)			
“Speedbird North” (Everything but engineering)	131.475	01293 463302 (SH) 01293 463301 (LH)	Ops .LGWKDBA Cust Svcs .LGWKPBA Connex .LGWKNBA Crew Ops .LGWHFBA
“Speedbird Despatch” (Load Control)		01293 666071	.LGWLCBA
“Speedbird Library” (0630-2230)		01293 462282	.LGWWCBA
“Alpha Tech” (Engineering all fleets)	131.875	01293 666883	.LGWKEBA

James Shepard

## Air to Air VHF

Africa/Indian Ocean	128.95
Atlantic	123.45
Canada N Domestic	131.8
Canada S Domestic	122.75
USA Low level	122.75
USA Hi level	122.97
UK Coastguard	132.65
FSS Canada	126.7

ACARS A/C to A/C I GAMP NLY

Time Signals	WWV	2.5, 5, 10, 15 MHz. (SSB/AM)
	CHU	3330, 7335, 14670 KHz (SSB)

## ATIS Phone numbers (2004)

Up to date info can be found at

[http://www.faa.gov/airports\\_airtraffic/weather/asos/](http://www.faa.gov/airports_airtraffic/weather/asos/) and <http://www.airnav.com/airports/>

Note: the ASOS phone numbers are different to the ATIS phone numbers.

Lambert St. Louis	STL	314-890-4777	
Chicago O'Hare	ORD	773-601-8921	
Detroit Metropolitan Wayne County	DTW	734-941-7848	
Indianapolis	IND	317-856-5748	
Newark Liberty	EWR	973-624-6463	973-824-4417
New York Kennedy	JFK	718-995-8188	
New York La Guardia	LGA	718-478-6070	718-478-6118
Boston Logan	BOS	617-567-0160	
Philadelphia	PHL	215-492-9617	
Washington Dulles	IAD	703-471-7127	
Baltimore-Washington	BWI	410-691-1278	
Atlanta Hartsfield	ATL	404-762-1121	
Jacksonville	JAX	904-741-4304	
Miami	MIA	305-870-0235	
Orlando	MCO	407-855-5235	
Fort Lauderdale/Hollywood	FLL	954-359-7857	
Tampa	TPA	813-873-7228	
Louis Armstrong New Orleans	MSY	504-471-4417	
Dallas/Forth Worth	DFW	972-615-2701	
Houston George Bush Intercontinental	IAH	281-443-1744	
Denver	DEN	303-342-0819	303-342-0820
Phoenix Sky Harbor	PHX	602-231-8557	
Las Vegas McCarran	LAS	702-736-0950	
Los Angeles	LAX	310-646-2297	
San Diego	SAN	619-298-0997	
San Francisco	SFO	650-877-3585	650-877-8422
Metropolitan Oakland	OAK	510-635-5850	
Seattle-Tacoma	SEA	206-241-6025	
Boeing Field	BFI	206-767-4113	